



HarvestMaster™

Information Machines for Agriculture

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Warranty and Repair Information

▲ Limited Warranties

HarvestMaster warrants that all *Pro4000* hardware components (except for the items listed below) shall be free from defects in materials and workmanship for a period of 12 months from the date of shipment when properly installed, calibrated, and operated in accordance with instruction manuals accompanying said hardware and used for the purpose for which said hardware was designed. Battery packs, elastomeric keyboards, the disk containing the *Pro4000* Utility Programs, and accessories are warranted for 90 days from the date of shipment.

In the event a defect in materials or workmanship is discovered and reported to HarvestMaster within the specified warranty period, HarvestMaster will, at its option, repair the defect or replace the defective product. This warranty does not apply where the product has been operating outside the environmental specifications of the product. HarvestMaster's obligation hereunder will be limited to such repair or replacement.

▲ Disclaimer of Warranties

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Removal of Serial Number

Removal of the serial number label from an instrument will void any warranty. HarvestMaster will not repair or update an instrument

and return it to an individual if the instrument is without a serial number label.

Factory Sealed Unit

The *Pro4000* is a factory sealed unit. There are no internal user serviceable parts. If the *Pro4000* is opened or in any other way tampered with, all warranties are null and void.

Updates or Modifications

HarvestMaster shall be under no obligation to update or modify its products except as herein noted to correct defects or errors. Furthermore, the customer agrees that all representations and warranties contained herein shall be immediately null and void in the event of any modification, alteration, or change in or to any product effected by or on behalf of customer except for a change made by HarvestMaster or other direct supervision thereof.

Extended Warranties

HarvestMaster offers a variety of warranty options to extend coverage beyond the standard warranty. Contact us for details.

Software Copyright

The Utility Programs are copyrighted by HarvestMaster, Inc. You may not rent, lease, lend, sub-license, modify, or disassemble them.

Shipping Products for Replacement or Repair

The customer has the responsibility to ship the equipment to HarvestMaster with all shipping costs prepaid. After repairing or replacing the equipment, HarvestMaster will ship the equipment, at its cost, back to the customer by the same type of carrier used by the customer to ship the equipment to us.

▲ Repairs

If your *Pro4000* is in need of repair or servicing, call for an RMA (Return Materials Authorization) number. Please have the following information ready when you call:

- *Pro4000* serial number
- Your name
- Name and shipping address of company/university/agency
- Phone and FAX number
- Clear description of the problem encountered
- Purchase order number and billing address (for equipment that is not under standard or extended warranty)

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Section 1

Introduction

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- Welcome
 - Features
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 - Creating Applications for the Pro4000
 - Utility Software Package
 - Familiarizing Yourself with the Pro4000

Welcome

As part of offering "Information Machines for Agriculture," HarvestMaster introduces the *Pro4000* FieldBook. The *Pro4000* is ideal for use on harvest data systems, the mapping of crop yields, the collection of field notes, and any number of mobile field computing application, including data acquisition from GPS receivers.

The *Pro4000* FieldBook operates much like a laptop computer, with solid state disk storage and a PC card slot. With a 486 processor, 66 MHz clock speed, and improved power management, the *Pro4000* is one of the most powerful rugged hand-held DOS computers available.

Data are hand-keyed on the keyboard or entered directly via instruments such as GPS receivers, lasers, and bar code scanners, etc.

If you have any questions or comments about the *Pro4000* after reviewing this manual, please feel free to contact us.



Agriculture Research Applications

- Plant Breeding Research
 - Field Notes
 - Plot Harvest Data Acquisition
 - Seed inventory
 - Strip Test Evaluation
- Site Specific Farming
 - Yield Mapping
 - Variable Rate Applicator Control
 - Weed Mapping
 - Soils Mapping and Testing
 - Field Navigation and Features Logging
- Agronomy Testing
 - On-Farm Testing of Field Treatments
 - Position Logging of Treatments
- Plant Physiology
 - Green House Notes
 - Automated Caliper Data Entry
 - Bar Code Data Entry
 - Automated Data Entry on Field Sensing Systems for Light Moisture
- Plant Growth and Irrigation Management
 - Attended Soil Moisture Measurement
 - On-Site Decision Analysis
 - Plant Growth Modeling

Features

The standard and optional features of the *Pro4000* are listed below. Depending on the model you ordered, your *Pro4000* may have one or more of the optional features.

▲ Standard Features

- MS-DOS Operating System, Version 6 22
- SC400 (486) Processor
- 66 MHz CPU
- 2 M Internal Random Access Memory (RAM) for Program Execution
- 4 M or 12 M Solid State Disk for Internal Program and Data Storage
- PCMCIA 2.0 Type II Card Slot
- 2 RS-232C Serial Ports
- 24 Character x 16 Line CGA Graphics Display with Backlight and Heater
- Elastomeric Keypad with 59 Keys or Rugged Membrane Keypad with 39 Keys
- Pro4000* Utility Programs (pre-installed in ROM, drive A:), includes:
 - *ProShell* DOS Shell Program
 - *ProEdit* Text Editor Program
 - *ProLink* File Transfer Program
- Real Time Clock/Calendar
- Rugged, Sealed Case

Detailed specifications can be found in *Section 7, Technical Reference*.

Accessories

▲ Standard Accessories

A basic *Pro4000* comes with the following accessories:

- User's Manual
- Battery Pack (Standard, Heavy-Duty, or External Input)
- Three Utility Software Disks:
 - 1- Lynx™ Windows File Management Utility and Installation Program
 - 2- MS-DOS Utilities
 - 3- MS-DOS Utilities, Disk Utility Files, and PC Card Drivers

Pro4000 Plus Package Option

If you purchased a *Pro4000* Plus Package, the accessories listed below are included in addition to the standard accessories (these items can also be ordered separately):

- RS-232 Serial Communication Cable
- Nylon Field Carrying Case
- AC Wall Mount SafeCharger

▲ Optional Accessories

- RS-232 Serial Communication Cable
- Nylon Field Carrying Case
- AC Wall Mount SafeCharger
- SmartCharger™
- Removable PCMCIA Cards
- Peripheral Interfaces
- Bar Code Accessories

▲ LandMark GPS

The *Pro4000* is an integral component of our LandMark GPS™ which provides sub-meter, real-time differential GPS. If you have a LandMark system, refer to the LandMark manual for information regarding the use of the *Pro4000* and the LandMark GPS.

Utility Software Package

A Utility Software Package is included with your *Pro4000*. The package includes a set of utility programs that run on your *Pro4000* and a communication program that runs on your PC.

Pro4000 Utility Programs

Utility Software Disks

The utility software disks includes the following *Pro4000* utility programs:

- MS-DOS utility files for the *Pro4000*. A subset of the MS-DOS utilities are factory installed on the *Pro4000*. Other utilities can be transferred to the *Pro4000* from the Utility Software disks as needed.
- Solid State Disk Utility Files
- PC Card Drivers

Most of the programs listed above are also factory installed on the *Pro4000*. The utility software disks can be used to re-install the programs if needed and to transfer additional utilities to the *Pro4000*.

Factory Installed Programs

The following *Pro4000* utility programs are factory installed on the *Pro4000*:

- ProShell DOS Shell Program (drive A:)
- ProLink File Transfer Program (drive A:)
- ProEdit Text Editor Program (drive C:)
- Commonly Used MS-DOS Commands (drive C:)
- PC Card Drivers (drive C:)

PC Utility Program

The Utility Software disk includes:

- Lynx™ Windows File Management/Communication Utility

For details, refer to *Section 5, Introduction to the Utility Software Package*

Creating Applications for the Pro4000

Applications can be developed for the *Pro4000* using standard DOS software packages and programming languages including DBase, FoxPro, C, and Basic. We also offer custom programming.

Familiarizing Yourself With the Pro4000

The *Pro4000* has many of the same features of a laptop or desktop computer, although there are inherent differences. These differences occur in the screen size, keyboard, data storage media, and power supply.

Before you get started on your *Pro4000* application, you can familiarize yourself with the unique features of the *Pro4000* by reading through this manual.

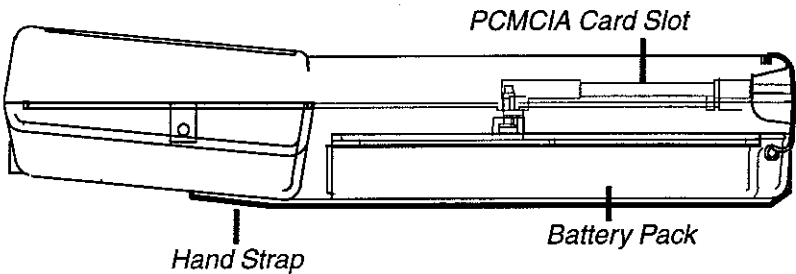
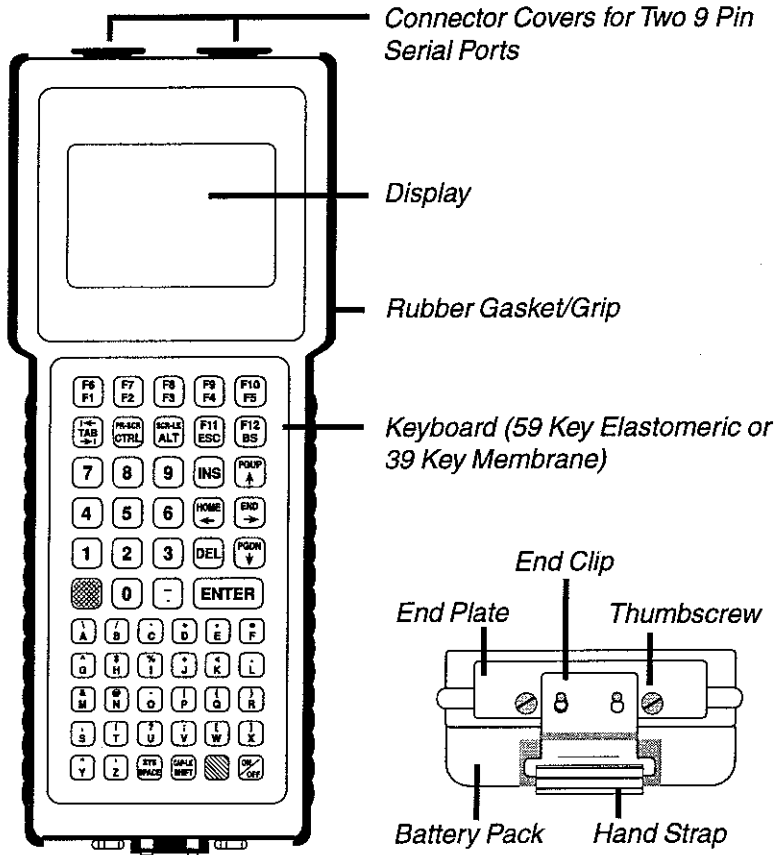
Section 2

Hardware Features

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- Hardware Components
 - Keyboard
 - Display and Full Screen
 - Communication Ports
 - Batteries

Hardware Components

The hardware components are rugged and waterproof, allowing the Pro4000 to be used in harsh field conditions.

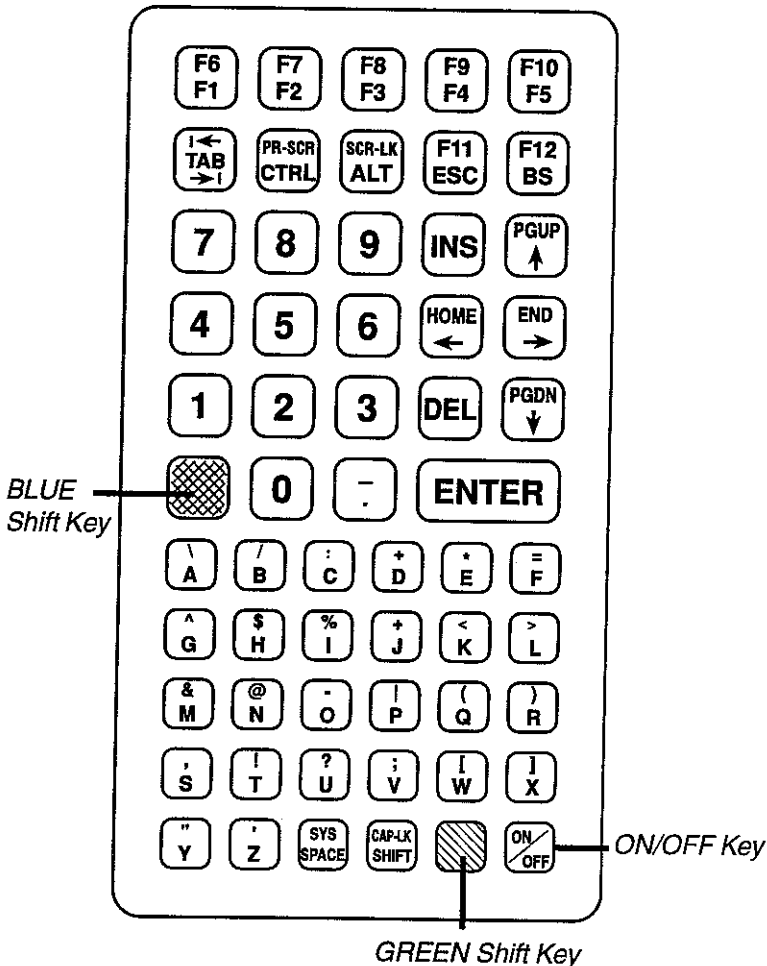


Keyboard

The *Pro4000* comes with your choice of a 59 key raised elastomeric keyboard or a rugged 39 key membrane keyboard. Both keyboards act as a standard IBM AT keyboard with some additional special key sequences.

▲ Elastomeric Keyboard

The elastomeric keyboard has 59 alphanumeric keys color coded by function, a separate numeric keypad, 12 function keys, and special DOS control keys.



Elastomeric Keyboard

Special Keys and Key Sequences

The keyboard options in black lettering are operational unless a GREEN or BLUE shift key is depressed. The green and blue key sequences and their functions are listed below (unless otherwise specified, press the colored key first, then the other key/s listed):

<u>Function</u>	<u>Key Sequence</u>
Select an upper character (shown in BLUE)	BLUE key + appropriate key
Control Break	<CTRL> + BLUE key + <SCR-LK>
Pan display window in the direction of the arrow	GREEN key + any arrow key
Toggle auto-panning on or off	GREEN key + (INS)
Decrease LCD contrast	GREEN key + <. > (or <->)
Increase LCD contrast	GREEN key + <D> (or <+>)
Toggle display backlight on or off	GREEN key + <BS>
Turn low power beeper off	GREEN key + <ESC>
Perform a hard reset (reboot)	<On/Off> (hold down for 8 to 10 seconds)

Green Shift Key Usage

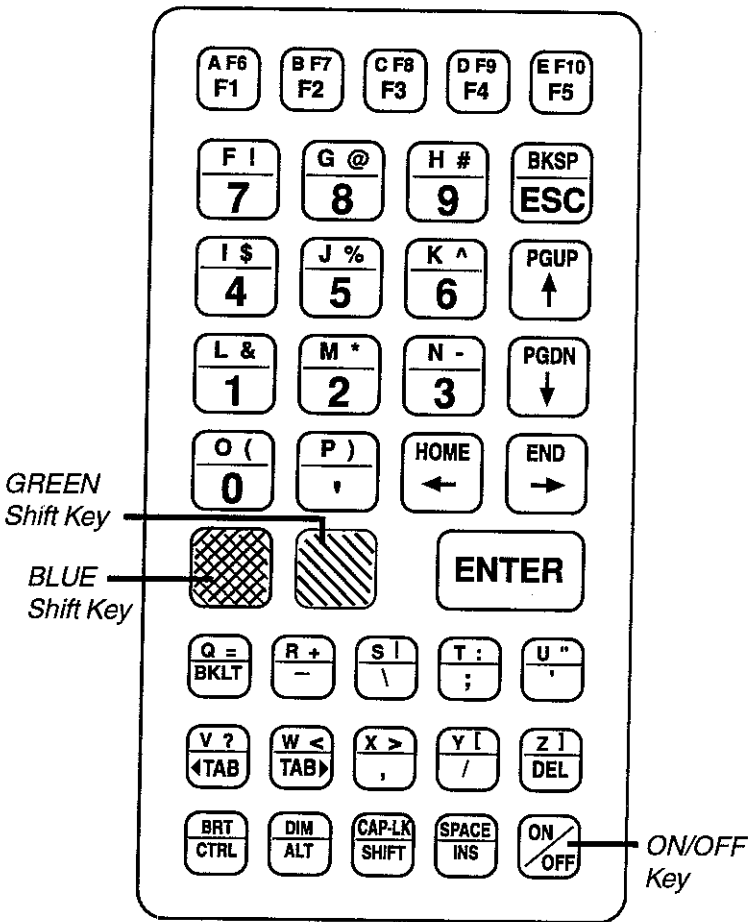
To access the keyboard options printed in green lettering, press and release the GREEN shift key followed by the key with the desired green-lettered option. To activate several green-lettered options before returning to standard mode, continue to hold the GREEN shift key down while you press the keys with the desired green-lettered options. Once the GREEN shift key is released, the keyboard reverts back to the standard mode.

Blue Shift Key Usage

To access the keyboard options printed in blue lettering, press and release the BLUE shift key followed by the key with the desired blue-lettered option. To activate several blue-lettered options before returning to standard mode, continue to hold the BLUE shift key down while you press the keys with the desired blue-lettered options. Once the BLUE shift key is released, the keyboard reverts back to the standard mode. To repeat a BLUE key character, press and release the BLUE key then hold down the character to be repeated.

▲ Membrane Keyboard

The membrane keyboard has 39 keys color coded by function, a separate numeric keypad, 10 function keys, and special DOS control keys. The alphabetic keys are accessed through the BLUE shift key or by putting the keyboard in alpha lock mode. The keys on the membrane keyboard are larger than those on the elastomeric keyboard and easily accommodate gloved fingers. The membrane surface is very durable and is extremely resistant to tears and punctures. Snap domes under the keys provide tactile feel when pressed.



Membrane Keyboard

Keyboard Modes

The membrane keyboard has two modes: standard and alpha lock. In standard mode (default) all options in black lettering are operational, unless a BLUE or GREEN shift key is depressed. In alpha lock mode, the alphabetic characters are operational unless a BLUE or GREEN shift key is depressed. Details on how the keyboard works in these modes follow.

Special Keys and Key Sequences

The keyboard options available on the elastomeric keyboard are also available on the membrane keyboard by using the BLUE and the GREEN shift key sequences (except F11, F12, PR-SCR, and SCRLK). The BKLT (backlight), DIM (dim), and BRT (bright) keys are unique to the membrane keyboard.

The special keys and key sequences and their functions are listed below (press the colored key first, then the key listed after the +):

<u>Function</u>	<u>Key Sequence</u>
Select a blue character	BLUE key + appropriate key
Select a green character	GREEN key + appropriate key
Toggle alpha lock mode on or off	Press GREEN and BLUE keys simultaneously
Temporarily override alpha lock to use a black key	BLUE key + appropriate key (when alpha lock is on)
Temporarily override alpha lock to use a green key	GREEN key + appropriate key (when alpha lock is on)
Pan display window in the direction of the arrow	GREEN key + any arrow key
Toggle auto-panning on or off	GREEN key + <INS>
Decrease LCD contrast	GREEN key + <DIM>
Increase LCD contrast	GREEN key + <BRT>
Toggle display backlight on or off	<BKLT>
Turn low power beeper off	GREEN key + <ESC>
Perform a hard reset (reboot)	<On/Off> (hold down for 8 to 10 seconds)

Blue Shift Key Usage

To access the keyboard options printed in blue lettering, press and release the BLUE shift key followed by the key with the desired blue-lettered option. To activate several blue-lettered options before returning to standard mode, continue to hold the BLUE shift key down while you press the keys with the desired blue-lettered options. Once the BLUE shift key is released, the keyboard reverts back to the standard mode.

Green Shift Key Usage

To access the keyboard options printed in green lettering, press and release the GREEN shift key followed by the key with the desired green-lettered option. To activate several green-lettered options before returning to standard mode, continue to hold the GREEN shift key down while you press the keys with the desired green lettered-options. Once the GREEN shift key is released, the keyboard reverts back to the standard mode.

Alpha Lock Mode

If you want to enter alpha text without having to hold down the BLUE shift key, you can place the keyboard in alpha lock mode by depressing the BLUE and the GREEN shift keys simultaneously. When alpha lock is activated, you hear a rising tone. To leave alpha lock mode, depress the BLUE and GREEN shift keys simultaneously again. When alpha lock is deactivated, you hear a falling tone.

❖ *Note: Black lettered ARROWS and CTRL, ALT, SHIFT, and ENTER keys continue to operate as though you were not in alpha lock mode.*

Overriding Alpha Lock to Access a Black or Green-Lettered Option

You can temporarily override the alpha lock mode to access a black-lettered option by pressing and releasing the BLUE shift key followed by the key with the desired black-lettered option. You automatically return to alpha lock mode. To activate several black-lettered options before returning to alpha lock, continue to hold the BLUE shift key down while you press the keys with the desired black-lettered options. You automatically return to alpha lock mode once the BLUE key is released (release it before pushing your last black-lettered key). If you enter a key in error, depress the back space (BKSP) key to erase the entry.

You can access a green-lettered option while in alpha lock mode by pressing and releasing the GREEN shift key followed by the key

with the desired green-lettered option. You automatically return to alpha lock mode. To activate several green-lettered options before returning to alpha lock, continue to hold the GREEN shift key down while you press the keys with the desired green-lettered options. You automatically return to alpha lock mode once the GREEN key is released (release it before pushing your last green-lettered key). If you enter a key in error, depress the backspace (BKSP) key to erase the entry.

▲ Typing Extended Characters

You can access characters that are not available on the keyboard by pressing the <ALT> key and typing the associated three digit ASCII character code on the keyboard. For example, you would press <ALT> <248> to access a degree symbol °. A list of extended characters can be found in the *Technical Reference*.

This feature can be enabled (default) or disabled through the extended BIOS functions (Refer to *Section 8, Programming Guide, Extended BIOS Functions*)

▲ Performing a Hard Reset

To perform a hard reset (reboot), hold down the <On/Off> key for 8 to 10 seconds (just long enough for the screen to clear). Do not hold the <On/Off> key down during the reboot process.

❖ *Note: When you turn the Pro4000 on or off, there is no "beep" when you press the <On/Off> key (other FieldBook models do have that feature). Also, it is normal for a horizontal line to appear briefly on the screen.*

Display and Full Screen

▲ Display

The display window is 3" wide x 2" high, allowing you to view 24 characters x 16 lines of information. A scratch-resistant, low-glare finish has been applied to the display bezel which covers the display. The display is a CGA extended temperature display.



Display Features:

- *Gray Scale*: with this setting, you can use up to 16 shades of gray. The normal setting is black and white
- *Shade Mapping*: converts colors and gray shades into black and white to achieve the best contrast
- *Contrast*: the display contrast can be increased or decreased.
- *Heater*: the display heater allows you to use the *Pro4000* in temperatures at or below freezing
- *Backlight*: the backlight enhances visibility
- *Auto-Panning*: the display window can be set up to automatically pan with the cursor (see Auto-Panning later in this section)

- *Video Modes*: There are two video modes: text mode and graphics mode. The program running on the *Pro4000* dictates which display mode is used. For example, if you were running LandMark GPS and drawing a map on the Map screen, you would be in graphics mode. When the *Pro4000* is in graphics mode, panning is not supported. For more information about Video Modes, refer to *Section 8, Programming Guide*.

The display features can be enabled, disabled, or adjusted through the System SetUp Program (refer to *Section 4, System SetUp Program, Keyboard/Display Screen* for more details). Some display features can also be adjusted using special key sequences as shown in the chart below:

<u>Display Feature</u>	<u>Key Sequence, Elastomeric KB</u>	<u>Key Sequence, Membrane KB</u>
Increase Contrast	GREEN + <+>	GREEN + <BRT>
Decrease Contrast	GREEN + <->	GREEN + <DIM>
Backlight Toggle On and Off	GREEN + <BS>	<BKLT>
Auto-Panning Toggle On and Off	GREEN + <INS>	GREEN + <INS>

▲ Full Screen

The *Pro4000* has a full screen stored in memory that is 80 characters wide by 25 lines deep. Because the size of the *Pro4000* display window is 24 characters x 16 lines, you can only view a portion of the full screen at a time.

**Pro4000
Display Window**

**24 characters wide
x 16 lines deep**

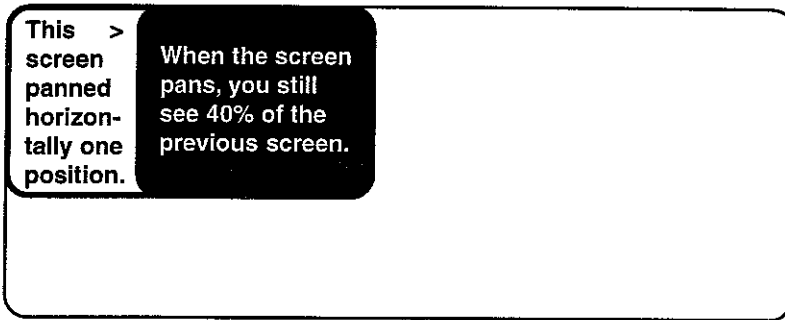
**Full Screen in
Pro4000 Memory**

**80 characters wide
x 25 lines deep**

You can view any part of the full screen by panning horizontally and vertically. Panning can be done automatically using Auto-Panning or manually using GREEN key + arrow key combinations.

Auto-Panning

When Auto-Panning is enabled, the screen automatically shifts (pans) as the cursor moves beyond the visible window. Roughly 40% of what you see in the new display window is part of the previously displayed screen, while 60% is the new area the cursor moved into.



When Auto-Panning is disabled, the screen does not shift as the cursor moves beyond the visible window. The display screen can be shifted by panning manually or through program control.

The Auto-Panning default is enabled. It can be turned off in the System SetUp Program (see *Section 4, System SetUp Program, Keyboard/Display Screen*). You can also toggle auto-panning on and off by pressing the GREEN shift key + <INS>.

Panning Manually

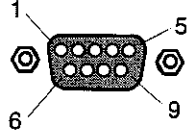
You can manually move the display window around the full screen by pressing the GREEN key followed by the desired arrow key. (See *Keyboard, Green Key Usage*, earlier in this section for details.) The visible display pans in the direction of the arrow. As with Auto-Panning, roughly 40% of what you see in the new display window is part of the previously displayed screen, while 60% is the new area (see graphic above). The cursor remains in its original position; it does not follow the window.

Communication Ports

▲ 9 Pin Serial Communication Ports

A *Pro4000* has two 9 pin serial communication ports (COM1 and COM2), allowing the simultaneous operation of two serial devices such as printers, modems, and bar code wands. The wall mount charger is connected to COM 1 to trickle charge the *Pro4000*. A serial communication cable (9 pin to 9 pin) for use with serial devices is available from *HarvestMaster*.

9 Pin D Connector Pinouts



COM1

1	Battery Charger Input or Data Carrier Detect (DCD) Input
2	Receive Data (RCD)
3	Transmit Data (TXD)
4	+5V Switched Supply or Data Terminal Ready (DTR) Output
5	Ground (GND)
6	Data Set Ready (DSR)
7	Request To Send (RTS)
8	Clear To Send (CTS)
9	Ring Indicator

COM2

1	Data Carrier Detect (DCD)
2	Receive Data (RCD)
3	Transmit Data (TXD)
4	Data Terminal Ready (DTR)
5	Ground (GND)
6	Data Set Ready (DSR)
7	Request To Send (RTS)
8	Clear To Send (CTS)
9	Ring Indicator

Limitations

If you want to connect a bar code wand to COM2, it might need its own power source because COM2 may not supply enough power for the wand

Batteries

The *Pro4000* design uses power much more efficiently than previous FieldBook models. More than double the amount of operating time can be realized in the field depending on your application. The Auto Suspend and Power Management features help to conserve power. Maintaining the battery pack and backup supply is also much simpler.

These battery design features are discussed in detail in this section of the manual.

▲ Batteries and Backup Power Supplies

There are three batteries and a backup capacitor associated with the *Pro4000*:

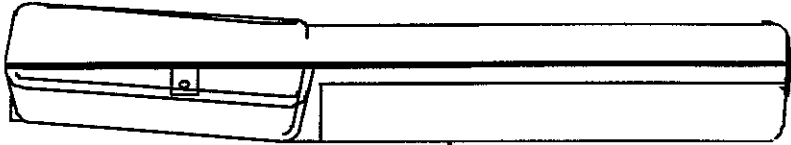
- ❑ NiCad Battery pack (main power source)
- ❑ Internal lithium backup battery (powers the real time clock and CMOS RAM)
- ❑ Super capacitor that serves as the RAM backup (maintains the RAM while you change the battery pack)
- ❑ SRAM memory card battery (maintains the card memory when the card is not powered by the *Pro4000*)

The batteries and the super capacitor are discussed in detail in this section.

▲ Battery Pack

The *Pro4000* is powered by a rechargeable nickel-cadmium (NiCad) battery pack with a heavy-duty option. A comparison of these batteries is shown below. The stated operating times are based on a typical application where the *Pro4000* is running at 33 MHz, the Power Manager is on, data are being entered manually on the keyboard, the backlight is used 10% of the time, and processing time is 20%. The actual operating time could vary from as little as 5 hours to as much as 80 hours, depending on your program and how the system is set up.

	<u>Standard Pack</u>	<u>Heavy-Duty Pack</u>
Capacity	1,700 mA hours	3,400 mA hours
Operating Time	12 to 18 hours	24 to 36 hours
Weight	5 lbs	1.1 lbs

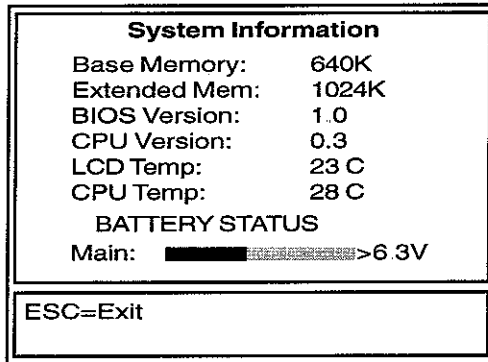


Battery Pack

Battery Pack Status

When you first receive your *Pro4000*, you should fully charge the battery pack before taking it into the field. Details on how to do this follow later in this section.

You can view the status of the battery pack on the System Information screen (refer to *System SetUp Program, Section 4* for details on how to view this screen). A sample screen is shown below:



The main battery status indicator is a bar graph with the voltage listed next to it. The bar chart is a graphical depiction of the operational battery power remaining. Because all batteries vary somewhat relative to total capacity, this graph should be used as a rough guide only. The voltage number is the current voltage of the battery pack. When the voltage drops to 5.9 V, it needs to be recharged.

❖ *Warning: The battery status depicted on the bar chart is not necessarily indicative of remaining battery life. The reading is the actual voltage, but does not indicate the charge level. Additionally, the rate of battery discharge varies depending upon the current required for your particular application.*

It is the nature of rechargeable batteries to indicate that they are fully charged even after a very short charging cycle. Only if the batteries are charged for their recommended time do they hold the charge for their

specified period of use. Therefore, if you charge a drained battery pack for a short period with the wall-mount charger (i.e. one hour) and view the battery status, it may appear that the pack is fully charged. It is not! The battery will quickly drain once the Pro4000 is operated.

Operating Time Between Charges

Power consumption varies depending on your application. If power saving features are used in the application and no external devices are powered by the Pro4000, the standard battery pack should last 12 to 18 hours during continuous use. The heavy-duty battery pack should last 24 to 36 hours.

Please note that as the batteries age, a pack will not operate as long on a charge as when it was new. The capacity could be reduced by as much as 50% at the end of its useful life.

Average power consumption rates for various activities are shown in the following chart.

Average Power Consumption Rates

<u>Activity</u>	<u>Power Consumption</u>
Power Off	0.2 mA
Suspend	1 mA
Processing	
- 2 MHz	55 mA
- 8 MHz	80 mA
- 16 MHz	100 mA
- 33 MHz	158 mA
- 66 MHz	240 mA
Keyboard Entry	60 mA
Heater On	an <i>additional</i> 250 mA
Backlight On	an <i>additional</i> 70 mA
Bar Code Wand	an <i>additional</i> 25 to 200 mA (depending upon the device)

PCMCIA cards also draw a small amount of current from the Pro4000. The amount drawn varies depending upon the type of card and its usage.

Power Management Features

To conserve power, the *Pro4000* has the following built-in power management features: Auto Suspend, Performance, and Power Manager. These features are controlled through the System Setup program. Refer to *Section 4, System SetUp Program, Power Management Screen* for details on how to set up these features.

Auto Suspend

When the Auto Suspend feature is on, the *Pro4000* turns itself off if there are no keystrokes after a specified period of time. The time ranges are from 5 to 75 minutes in 5 minute increments. Auto Suspend monitors only keystrokes, not processor activity. If you will be processing information for extended periods without keyboard input, you should turn the Auto Suspend function off.

Performance

The Performance setting allows you to set the speed of the CPU, which is directly proportional to power consumption. The Performance settings are Hyper (fastest), High, Medium, Low, and Miser (lowest). If the Power Manager is enabled, the Performance setting affects the range of speeds at which the CPU runs. When the Power Manager is turned off, the Performance setting causes the CPU to run at a fixed clock speed as shown in the chart below under the heading "Power Manager Off "

Power Manager

The BIOS Power Manager is a sophisticated mechanism which automatically speeds up and slows down the system CPU based on the level of activity. Activities monitored include keypresses, serial port activity, changes to video memory, file system activity, and PC card activity. When there is a high degree of activity, the system runs at a faster rate. When there is a lesser degree of activity, the system runs at a slower rate, consuming less power. The following table gives clock speeds in MHz for the five performance levels with the Power Manager on or off.

<u>Performance Setting</u>	<u>Power Manager On</u>	<u>Power Manager Off</u>
	Processing/Idle	
Hyper	66/8	66
High	66/4	33
Medium	33/2	16
Low	16/1	8
Miser	8/1	2

The Power Manager can greatly extend the life of the batteries. We recommend that you run the *Pro4000* with the Power Manager on. You can gain even more power management efficiency within your application program by following the recommended power management techniques discussed in *Section 8, Programming Guide*

What Happens as Battery Voltage Drops

When the battery pack voltage drops to 5.9V, a beep sequence sounds and the display flashes on and off once per minute to let you know it is time to recharge the battery pack. The beeps occur more frequently as the voltage gets lower, changing from once per minute to once every 30 seconds until the pack is charged or replaced. The beeper can be toggled off by pressing the hot key sequence <GREEN> + <ESC> on the keyboard. If the *Pro4000* is turned off, the beeper sound defaults back to "on" when the unit is turned on again.

Once the warning has sounded, you have from ten minutes to one hour (depending upon power consumption) to save your data and exit your program. Once you have done this, you should turn off the *Pro4000* and either change or recharge the battery pack.

When the battery voltage reaches 5.65 V or less, the *Pro4000* goes into suspend mode. When the battery voltage drops below 4 V, the *Pro4000* completely shuts down. If you allow the battery voltage to get this low, the *Pro4000* reboots after you charge or replace the battery pack. Any data that was not saved to disk is lost

Recharging the Battery Pack

❖ *Important Note: If the battery voltage gets low enough for the beep sequence to sound and the display to flash as described above, you should change or charge the battery pack right away.*

You should always be aware of the status of the main battery pack before you go out into the field to collect data. The battery pack may need to be recharged before you go. You need to take into account how much battery life is left and the amount of time required to charge the battery pack.

You probably will not need to charge the battery pack every day. As mentioned earlier, this is totally dependent on your application. You may be able to go several days between charges. It is best to use as much battery capacity as possible in your application before charging the battery pack. After you have worked with the *Pro4000* for awhile, you will be able to settle into a charging routine.

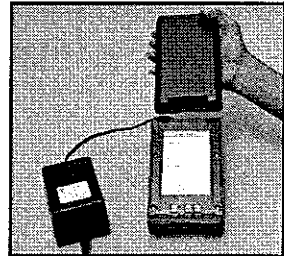
For example, let's say you collect data for eight hours per day for two days with your *Pro4000* and almost completely discharge the battery pack. A good routine would be to transfer the collected data to your PC after the second day then plug your *Pro4000* into a SafeCharger before leaving for the evening. When you come to work in the morning, the *Pro4000* will have fully charged batteries and be ready to collect the data for two more days. If you use your *Pro4000* for shorter intervals or sporadically, you can go even longer before charging the battery pack.

Charging Accessories

HarvestMaster offers the following charging accessories:

□ **SafeCharger, 110 or 220 Volt AC:** With a wall mount SafeCharger the battery pack is recharged without removing it from the *Pro4000*. Plug the AC charging adaptor into any 110 V (model PW-WB110) or 220 V (model PW-WB220) AC outlet and insert the SafeCharger connector into COM1 on the *Pro4000*. It takes 12 to 14 hours to fully charge a battery pack. You can leave the *Pro4000* connected to the SafeCharger continuously without damaging the batteries, thus the name "SafeCharger" (Refer to *Section 8, Appendix, SafeCharger Operating Instructions* for more details.)

□ **SmartCharger:** The SmartCharger discharges and/or quick-charges battery packs. Battery packs can be fully charged in about 2 hours. We recommend that you discharge battery packs every 1 to 2 months. This practice helps prevent a "memory effect" from developing in the batteries. (Refer to the *Appendix, SmartCharger Operating Instructions* for more details.)



□ **Cigarette Lighter Power Adaptor:** With this adaptor, you can charge battery packs via an automobile cigarette lighter. It takes approximately 14 hours to fully charge a pack. (This varies depending on whether or not the vehicle is running during part or all of the charging time. If it is not, it may take longer than 14 hours.) The *Pro4000* should not be connected to this charger for more than 24 hours or damage to the batteries will occur.

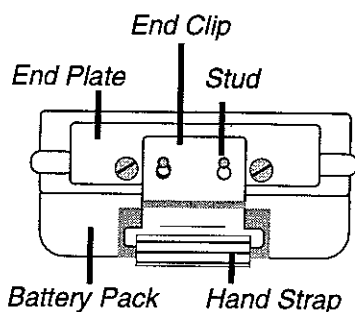
Changing the Battery Pack

Follow these steps to change the battery pack:

1) Before you remove the battery pack, save your data to disk, exit from your program, and turn the *Pro4000* off.

❖ *Important Note: If the Pro4000 is running in Suspend/Resume mode, the battery pack needs to be replaced within 15 minutes. Otherwise, the internal backup supply may be depleted, causing the Pro4000 to reboot instead of resume when you turn it back on.*

2) The battery pack is located on the back of the *Pro4000*. To remove the pack, pull on the hand strap until you have enough slack to remove the end clip from the metal studs on the end plate.



3) Remove the battery pack by sliding it towards the bottom of the *Pro4000*.

<< Slide to remove or insert >>

Battery Pack

4) Insert a fresh battery pack by aligning the runners and sliding it into place.

5) Once the battery pack is in place, secure it by pulling on the hand strap and placing the end clip holes over the metal studs on the end plate.

When you turn the *Pro4000* on, it will be in one of the states listed below, depending on which mode it was in when it was turned off:

- Resume/Suspend: the *Pro4000* resumes in the same place it left off before you turned it off and changed the battery pack

Exceptions: If the battery pack was removed from the *Pro4000* for longer than 15 minutes or the battery voltage is less than 4V, the *Pro4000* reboots when the new battery is installed and the unit is turned on

- On/Off: the *Pro4000* reboots

Storing the Pro4000 During Inactive Periods

To protect the *Pro4000* FieldBook and your files during long or short-term storage periods, please take the following precautions:

- Save all data and programs you want to keep to disk.
- Make a backup of programs and files.
- Store the *Pro4000* in a cool location (<20°C, 68°F).

Your data and programs are secure as long as they have been saved to disk, even if the batteries become discharged. The data storage disk is non-volatile. It does not depend on the battery to store the data for extended periods.

Using a SafeCharger to Maintain the Batteries During Storage

You can keep the batteries charged during storage using a SafeCharger so the *Pro4000* will be ready to use when needed. Install a battery pack on the *Pro4000*, connect a SafeCharger to the *Pro4000*, and plug the SafeCharger into an AC power outlet. Once the battery pack is fully charged, the SafeCharger automatically switches to trickle charge mode. You can leave the *Pro4000* in trickle charge mode continuously without damaging the batteries.

Storing the Pro4000 With a Discharged Battery Pack

If the battery pack is discharged during storage, you need to charge it before you can go into the field. A SmartCharger takes only 2 hours to fully charge a discharged pack. It takes about 12 hours to fully charge a battery pack using a SafeCharger. (Refer to *Section 8, Appendix* for battery charging instructions.) The *Pro4000* reboots when a charged battery is attached and you turn it on.

❖ *Note: If the battery pack was left in a discharged state for more than three months, leave it on a SmartCharger for 4 to 6 hours or attached to a SafeCharger for 24 hours*

Spare Battery Packs

Spare battery packs should be stored in a cool location. Avoid placing battery packs "contact side" down on a metal surface. Also, do not stack packs so that their contacts touch one another. These practices will cause the batteries to drain. The shelf-life of a battery pack is about two months. Before using a spare pack, you should charge it.

A Battery Pack's Useful Life

Battery packs can be recharged approximately 600 times before they need to be replaced. This is dependent on the temperatures they have been exposed to, operating conditions, and charging and discharging practices.

Recycling the Nickel Cadmium Batteries

The nickel cadmium batteries inside the *Pro4000* battery packs are recyclable. The RBRC (Rechargeable Battery Recycling Corporation) Battery Recycling Seal on the battery pack indicates that HarvestMaster is voluntarily participating in an industry program to collect and recycle these batteries when they are taken out of service in the United States or Canada. The RBRC program provides a convenient alternative to placing used NiCad batteries into the trash or the municipal waste stream, which is illegal in some areas. The batteries are recycled using a thermal process that extracts the cadmium, nickel, and iron content from the batteries. None of the by-products from this process are landfilled. Our involvement in this program is part of our commitment to preserving our environment and conserving our natural resources.



Some stores provide NiCad battery recycling bins for public use (Wal-Mart, Ace Hardware, Circuit City, and Radio Shack, for example). Please call 1-800-8-BATTERY for information on NiCad battery recycling in your area. You are also welcome to return your spent battery packs to HarvestMaster and we will recycle the batteries for you. If you plan to do this, please contact us for information on how to properly package and ship the batteries.

▲ Short-Term Backup Supply

The *Pro4000* has a super capacitor that behaves like a backup battery. When the battery pack is removed, the capacitor maintains the memory for up to 15 minutes, allowing you plenty of time to change the battery pack. The capacitor cannot operate the *Pro4000*.

The capacitor is charged by the battery pack. It holds a charge as long as the batteries or external power are supplied. When a battery pack is replaced, the capacitor charges up to full capacity in about 10 minutes.

If power is not supplied to the capacitor (for example, the battery pack is removed and left off the *Pro4000* for more than 15 minutes), the *Pro4000* reboots when the battery pack is replaced or charged. All the programs, data, and applications saved to the disk are safe. Information that was not saved to the disk is lost.

The super capacitor should last through the life of the *Pro4000*

▲ Backup Battery, Real Time Clock

A 3.6 V lithium backup battery supplies current to the *Pro4000* to maintain the real time clock when the battery pack voltage falls below 4 V or it is removed from the *Pro4000*. This battery should last for at least 5 years.

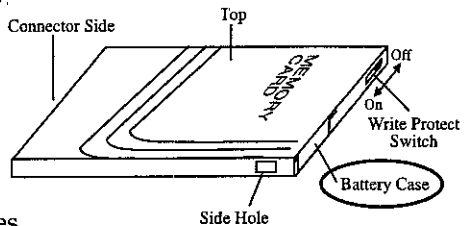
Replacing the Lithium Backup Battery

There is not a battery indicator for the lithium backup battery. If your *Pro4000* does not hold the date and time or you get a CMOS error, it may need to be replaced. You must return your *Pro4000* to HarvestMaster for lithium backup battery replacement.

▲ SRAM Memory Card Battery

SRAM memory cards (an optional accessory) are powered by the *Pro4000* when it is turned on. The SRAM card's internal lithium battery retains the memory when the *Pro4000* is off and when the card is not installed in the *Pro4000*.

Make sure that a battery is installed in a SRAM card before using it. Please refer to the manufacturer's instructions for details.



The life of these batteries varies greatly depending on usage and the memory size of the card. If the lithium battery is drained, the information stored on the card is lost. When a new battery is installed, the card needs to be formatted. The manufacturer's instructions that came with the card should include information on battery life and recommended changing intervals.

Replacing SRAM Card Batteries

SRAM card batteries are readily available at most stores. Unless the manufacturer's instructions state otherwise, we recommend that you change the battery every six months.

Section 3

Memory Configuration

Program and Data Storage Options

-
- Internal Memory
 - Program and Data Storage Options

Internal Memory

The *Pro4000*'s internal memory is configured much like the memory in laptop computers. It consists of ROM (Read Only Memory) and RAM (Random Access Memory).

▲ Read Only Memory (ROM)

ROM is used to store the operating system, BIOS, and Utility programs. The files on the A: drive of the *Pro4000* are located in the ROM. Information in the ROM is electronically "burned" into a chip before the chip is installed at the factory. Information stored in ROM cannot be altered but can be read or copied. This information remains intact whether the system power is on or off.

▲ Random Access Memory (RAM)

RAM is often referred to as the computer's workspace. This is where programs are executed or run. RAM can be written to, read from, erased, etc. Its storage ability is temporary in nature, only holding information while the system has power (although the *Pro4000* does not have to be turned on). If the battery pack is drained or power is interrupted for any reason, everything stored in RAM is lost. The backup capacitor saves the contents of RAM for a limited time while you change the battery pack (see *Section 2, Batteries*, for details).

The *Pro4000* has 2 M (megabytes) of internal RAM divided into three blocks:

Extended Memory Block	Above 1 M
Upper Memory Block	640 K to 1 M
Base (Conventional) Memory Block	0 to 640 K

Base Memory

The Base memory is the first 640 K of RAM in the *Pro4000*. The operating system and applications are executed within this area of memory. When the 640 K of Base memory is not enough for program execution, part of Extended memory can be used (see *Extended Memory* below).

Upper Memory

Reserved memory is the block between 640 K and 1 M. A small amount of reserved memory is available to load device drivers high. The DOS memory management utility EMM386 must be loaded into the CONFIG.SYS file (refer to *Section 6, DOS Commands* for details).

The CONFIG.SYS file loaded onto the *Pro4000* at the factory loads EMM386.SYS as a device driver.

Extended Memory

Extended memory is the area above 1 M. Application programs can use this area of memory if the application was specifically written to use extended memory.

High Memory

The first 64 K of Extended Memory is called the High Memory Area (HMA). The operating system can be loaded into the HMA to free up some Base Memory. The DOS memory management utility HIMEM must be loaded into the CONFIG.SYS file and the command line "DOS=High" must be added (refer to *Section 6, DOS Commands* for details).

The CONFIG.SYS file loaded onto the *Pro4000* at the factory loads the HIMEM.SYS and includes the statement DOS=High

▲ Drive Assignments

The solid state disk and PC memory cards are accessed by typing in their drive assignment letters at the DOS prompt.

The drive assignments are as follows:

- A: ROM
- C: Solid-State Hard Disk
- D: PC Card (if used)

Program and Data Storage Options

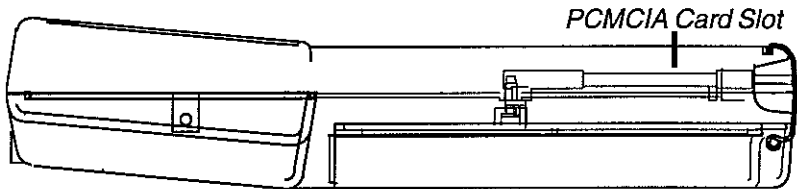
The *Pro4000* has two options for storing programs and data: a solid-state hard disk and a slot for PC cards

▲ Solid State Hard Disk

The solid state hard disk is used to store programs and data. It can be read from and written to just like the hard disk on a PC. Programs cannot use the disk as part of their executable workspace. The hard disk is non-volatile so information stored on it is retained even when no power is supplied to the *Pro4000*. There are two size options: 4 M or 12 M. The drive letter of the solid state disk is C:

▲ PC Cards and I/O Cards

The *Pro4000* has a user-accessible PCMCIA 2.0 Type II card slot that allows you to add mass data storage and I/O capabilities to your *Pro4000* with PC cards. The drive letter associated with the PC card slot is D:.

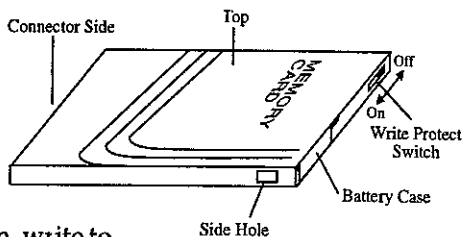


PCMCIA stands for the "Personal Computer Memory Card International Association." This association has developed standards for PC cards. PC cards are about the size of a credit card and come in three thicknesses or types

The PC card slot accepts Type I (3.3 mm thick) or Type II (5.0 mm thick) cards. These cards include SRAM (Static Random Access Memory), ATA Flash cards, or Input/Output Type II device cards. All types have a 68 pin connector for attachment to the *Pro4000*. The cards must be 5 V or 5 V/3 V (cards that are 3 V only are not supported).

A memory card is a solid state, self-contained memory board housed in a credit card-sized package. There are several types and brands of cards on the market.

These cards behave like hard disks. You can read from them, write to them, and erase single files from them. Standard DOS commands can be used (with one exception discussed under SRAM cards)



SRAM Cards

Power

SRAM cards are powered by the *Pro4000* while installed in the PC card slot. An on-board battery retains data when the card is not being powered by the *Pro4000*. Some brands have a replaceable lithium battery (coin type). If you have this type, make sure that the battery is installed before attempting to use the card. Other brands have a rechargeable battery that is automatically recharged while it is inside the *Pro4000*. The rechargeable batteries are not replaceable

If the lithium battery is drained, the information stored on the card is lost. We recommend that you change the battery every six months. Please refer to the manufacturer's instructions.

Formatting SRAM Cards

SRAM cards come pre-formatted. Files and directories can be copied onto it just like a standard disk drive. If you need to format a card, enter the following command into the *Pro4000* from the DOS prompt:

Format D:

❖ *Warning: Formatting the SRAM card will delete everything previously stored on the card. For more information on using FORMAT, refer to the MS-DOS Help.*

ATA Flash Cards

ATA Flash cards provide solid state data storage. Power is not required to maintain the data. They come in sizes ranging from 1 M to 180 M. ATA cards will work at any processor speed and while the *Pro4000* is in resume mode (Refer to *Chapter 4, System Setup Program* for details about these settings).

Formatting ATA Flash Cards

ATA Flash cards come pre-formatted. If you need to format a card, enter the following command into the *Pro4000* from the DOS prompt:

Format D: /u

❖ *Warning: Formatting the ATA Flash card will delete everything previously stored on the card. For more information on using FORMAT, refer to the MS-DOS Help*

Input/Output Device Cards

Input/Output Device cards can add additional communication capabilities to your *Pro4000*. Common I/O cards include fax/modem, network, and GPS cards. Refer to the manufacturer's instructions for information on how to use these cards and for information about hardware or software accessories that may be required. Contact our sales department for information on compatible cards and technical information about the installation and operation of the cards.

PC Card Drivers

The CardSoft PC card drivers and utilities by System Soft are factory-installed on the *Pro4000*. These programs provide the socket and card services necessary to operate the card. The lines pertaining to the drivers have already been added to the CONFIG.SYS file which resides on the *Pro4000* (Refer to *Section 6, Operating System* for information about the drivers and the CONFIG.SYS file.)

Displaying Information About the PC Card

You can display information about the installed PC card such as the card type and the name of the manufacturer using the CARDINFO utility. Follow these steps:

```
Change directories to the c:\cardsoft directory
Type: cd\util\cardsoft
Type cardinfo
```

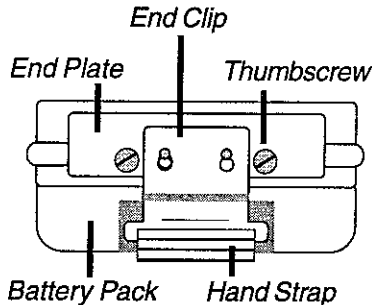
The following information is displayed:

```
Slot 1:
[Card Information]
Card Type = "ATA Disk" (Drive D:)
Manufacturer = <Vendor Name>
ProductName = <Vendor Product Name>
```

Inserting and Changing Cards

1) If you are using an SRAM card, make sure the battery is installed (if required) and that the card has been formatted. ATA cards should be ready to use.

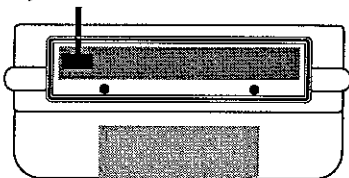
2) The card slot is located at the bottom of the *Pro4000* under the end plate. To access it, first remove the end clip by pulling on the hand strap until you have enough slack to remove it from the metal studs on the end plate.



3) Unscrew the thumbscrews using a screwdriver or a coin and remove the end plate.

4) PCMCIA cards have a 68 pin socket on one end. Insert the card socket-first. Be sure the front of the card is facing up (Cards can be taken out or put into the card slot while the *Pro4000* is on or off.)

Eject Button



< Insert Socket
< End First



5) To remove a card, push the eject button, grasp the card firmly, and pull it out.

❖ *Important Note: Be very careful when inserting and removing cards. Excess force could damage the card and the card drive. Do not remove or insert a card when the computer is trying to write to it. Incomplete files can corrupt the data already stored on the card.*

6) Replace the end plate and finger tighten the thumbscrews. Using a screwdriver or coin, turn the thumbscrews another 3/4 of a turn (the thumbscrews should not be tightened with more than 4" /lb of torque).

Section 4

System SetUp Program

System SetUp Program

System SetUp Program

Use the SetUp program to configure your *Pro4000*. The parameters you edit with SetUp include:

- System Date and Time
- Processing Speed
- Keyboard Configuration
- Display Configuration
- Auto-Panning (On or Off)
- Power Management

Executing SetUp

SetUp is resident on the system ROM and can be executed from DOS or from ProShell, the DOS Shell program.

Executing SetUp from ProShell

From the ProShell main menu, press the <TAB> key (Refer to *Accessing ProShell on the Pro4000, Section 5*). The Utility menu appears. Press <3> to select SetUp. The SetUp main menu screen is displayed.

Executing SetUp from DOS

To run the SetUp program from DOS, type:

```
Setup <ENTER>
```

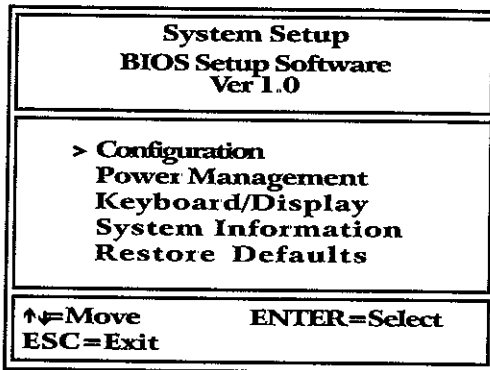
The SetUp main menu screen is displayed.

If you receive an error message after issuing this command, check to ensure that drive A: is referenced in your path statement in the AUTOEXEC.BAT file. If it is not referenced, you will need to type "A:Setup" at the C: prompt.

▲ SetUp Program Screens

Main Menu Screen

When you execute SetUp, the main menu screen is displayed. Five System SetUp screen options are listed. Use the up or down arrow keys to highlight the screen you want to view and press <ENTER>.



The parameters and options found on the SetUp screens are described on the following pages. The default values are underlined. You can select and edit the parameters using the keystrokes listed below.

<u>Key</u>	<u>Function</u>
Arrow Keys	Move between parameters
F1	Scroll through options starting with the previous value.
F2	Scroll through options starting with the next value
ENTER	Select highlighted option
ESC	Exit current SetUp screen and return to the main menu.

Configuration	
Date: >Feb 22, 1999	
Time: 14: 12: 44	
Boot Seq: C: then A:	
←→=Move	F1=Prev
ESC=Exit	F2=Next

Configuration Screen

Date: Month=Jan-Dec, Day=1-31, Year=1980-2099

Time: Seconds=0-59, Minutes=0-59, Hours=0-23
Time is expressed in the standard 24 hour format (military time).

Boot Sequence: C then A, A then C

Determines the primary and secondary boot drives. The system always boots from the primary drive unless it is malfunctioning in which case it attempts to boot from the secondary drive.

Power Management	
Power Key:	> Susp/Res
Auto Suspend:	50 Min
PC Card Susp:	On
Performance:	Hyper
Power Mgr:	On
DIR Conf:	RS-232
←↑↓→=Move	F1=Prev
ESC=Exit	F2=Next

Power Management Screen

Power Key (ON/OFF): Suspend/Resume or On/Off

In On/Off mode, the system clears and reboots when the Power Key is pressed. In Suspend/Resume mode, the system becomes suspended when the Power Key is pressed or when the preset Auto Suspend time interval is reached (5 to 75 minutes, see below). The screen turns off and the processor stops running, but the system does not reboot. When you press the Power Key again, the *Pro4000* resumes where it left off.

Auto-Suspend: Off or 5 to 75 minutes

If Auto-Suspend is turned off, the *Pro4000* stays on until you turn it off or the batteries are drained. If Auto-Suspend is assigned a time limit, the *Pro4000* turns off when the time limit passes with no keyboard activity.

PC Card Suspend: On or Off

This setting determines whether the PC card remains powered when the system is suspended. This allows AIA Flash cards to operate in Suspend/Resume mode. If you are using an AIA Flash card, set this to "On." For SRAM cards, this can be set to "Off."

Performance: Hyper, High, Medium, Low, Miser

This function sets the 486 processor clock speed for varying levels of power/performance. When the processor runs faster, it requires more power and drains the battery more quickly. For maximum time between battery charges, set this function to the lowest level that still gives adequate performance. If battery charge is not a concern, set Performance to "High" or "Hyper."

❑ **Power Manager: On or Off**

The Power Manager can help extend battery life by automatically speeding up and slowing down the 486 processor based on system activity. Activities include keypresses, serial port transfers, and video updates. The Power Manager should work fine for most applications, but in some cases it may need to be turned "Off." When the Power Manager is "Off," the processor runs at the same speed all the time regardless of activity. The following table gives clock speeds in MHz for the five performance levels with the Power Manager "On" or "Off."

<u>Performance Setting</u>	<u>Power Manager On</u>	<u>Power Manager Off</u>
	Processing/Idle	
Hyper	66/8	66
High	66/4	33
Medium	33/2	16
Low	16/1	8
Miser	8/1	2

❑ **DTR Configuration: RS-232, 5V DTR, 5V On, 5V Off, 5V Auto**

This setting applies to the Data Terminal Ready (DTR) signal on COM 1 (pin 4 of the D-9 connector). For normal operation it should be set to "RS-232" where it transmits DTR signals at RS-232 voltage levels (approximately +/- 6 V). All of the other settings cause pin 4 (normally the DTR signal) to transmit at 0-5 volt levels where it may be used to power external serial devices (up to 250 mA)

<u>Setting</u>	<u>Voltage Level</u>
5V DTR	0-5 V levels (tracks the state of the RS-232 DTR signal)
5V On	5 V constantly
5V Off	0 V constantly
5V Auto	Tracks the power state of the serial ports

Keyboard/Display	
Key Tone: Key Click	>Medium On
Auto Pan:	Enabled
Backlight:	Off
Heater:	Off
Video Map:	B/W1
Contrast:	36
←↑↓→ Move ESC=Exit	F1=Prev F2=Next

Keyboard/Display Screen

Key Tone: Low, Medium, High

Sets the frequency of the speaker for key clicks.

Key Click: On or Off

When "On" is selected, an audible beep is sounded when a key is pressed. When "Off" is selected, there is no sound.

Auto-Pan: Enabled or Disabled

When auto-panning is "On," the screen pans as the cursor moves beyond the visible window. When it is "Off," the screen does not pan when the cursor leaves the visible window. You can move around the screen manually using GREEN key + arrow key combinations on the keyboard. (Refer to *Display, Section 2*, for more details.)

Backlight: On or Off

A backlight for the display is standard. Manually toggle it on and off using the GREEN key + <BS> key on the elastomeric keyboard or the <BKLT> key on the membrane keyboard. The backlight uses an additional 70 mA of current.

Heater: On or Off

The heater setting should be set to "On" when temperatures are at or below freezing and the display begins to get sluggish. When the heater setting is "On," the Pro4000 monitors the display temperature every five minutes. If the temperature is less than 0° C then the heater is turned on. When the temperature is above 0° C, the heater is turned off. The Pro4000 does this automatically. When the heater is on it uses 250 mA of current. When the heater setting is "Off", the heater is always off.


□ Video: B/W1, Gray Scale, B/W2

This feature controls how CGA colors are mapped to the LCD screen: black and white (B/W1 or B/W2) or 16 shades of gray (Gray Scale). Both B/W settings map the attribute byte for each character on the screen to either black on white (normal) or white on black (inverted). Values for the foreground and background attributes are computed based on RGBI content. The attribute with the highest value is assigned black, the other is assigned white. In general, lighter colors map to black, darker colors map to white. These settings apply to text mode only. Graphics mode is always mapped to shades of gray.

"B/W1" is more power efficient but it requires that the video stream used by an application program goes through the BIOS instead of being written directly to memory. Some programs do this and some do not. "B/W2" requires more processing overhead, but should work with all application programs because it does not require the video stream to go through the BIOS.

□ Contrast: 0...32 to 63 ratio

This field adjusts the LCD character/screen contrast from 0 to 63. The contrast can be adjusted in the field without getting into the SetUp program. On the elastomeric keyboard, press the GREEN key + <> (or <->) to decrease the contrast or the GREEN key + <D> (or <+>) to increase the contrast. On the membrane keyboard, press the GREEN key + <DIM> to decrease the contrast or the GREEN key + <BRT> to increase the contrast.

System Information	
Base Memory:	640K
Extended Mem:	1024K
BIOS Version:	1.0
CPU Version:	0.3
LCD Temp:	23 C
CPU Temp:	28 C
BATTERY STATUS	
Main:	 >6.3V
ESC=Exit	

System Information Screen

Base Memory

This is the total amount of Base Memory in the system.

Extended Memory

This is the total amount of Extended Memory in the system.

BIOS Rev

This field reports the BIOS version installed in the *Pro4000*.

CPU Version

This field is the version of the SC400 processor.

LCD, CPU Temperature

Displays the temperature of the LCD display and the CPU in degrees C.

Main Battery Status

The bar chart is a graphical depiction of the operational battery power remaining. Because current requirements for each application are different, this graph should be used as a rough guide only. The current voltage of the battery pack is shown next to the bar chart. When the battery voltage reaches 5.9 V, the *Pro4000* should be recharged. (See *Batteries, Section 2*, for more details.)

Section 5

Utility Programs

-
- Introduction to the Utility Software Package
 - ProShell DOS Shell Program
 - File Transfer Programs
 - Text Editor Program

Introduction to the Utility Software Package

A Utility Software Package is included with your *Pro4000*. The Package includes a set of programs that run on your *Pro4000* and a Windows-based file management utility that runs on your computer. These programs are described below.

<u>Function</u>	<u>Pro4000 Program</u>	<u>PC Program</u>
DOS Shell	ProShell (PS.COM)	
File Transfer	ProLink (PL.COM)	
Text Editor	ProEdit (PE.COM)	
Windows File Management Utility		Lynx

Utility Program Installation

The *Pro4000* Utility Programs ProShell, ProEdit, and ProLink are factory installed in the *Pro4000*'s ROM. Lynx must be installed on your computer (refer to *File Transfer Programs* later in this section).

ProShell DOS Shell Program

ProShell is a DOS Shell program that runs on the *Pro4000*, making the operation of the *Pro4000* easier. Instead of issuing DOS commands, you select the options you want to execute from menus. Fewer keystrokes are required than with the standard DOS command line environment.

Accessing ProShell on the Pro4000

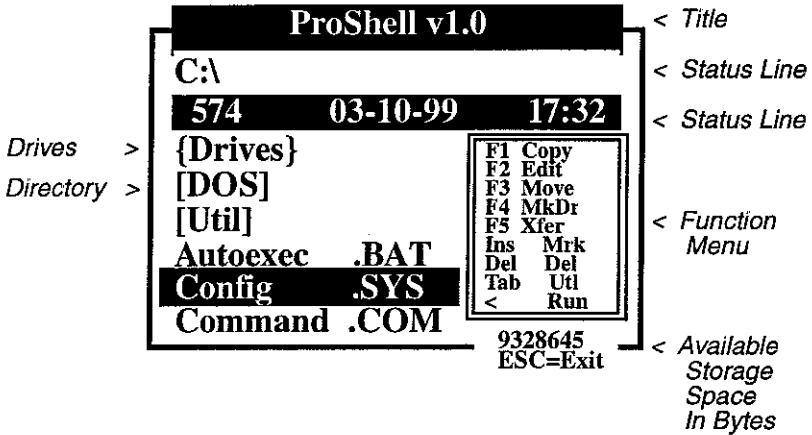
ProShell is installed in the *Pro4000*'s ROM. It can be executed from any drive (it is assumed you are running ProShell from the C: drive in the examples given in this section).

❖ *Note: When the system is rebooted, the path is always set as follows: Path = A:\;C:\. If the path is overwritten by the user and A:\; is not included in the path statement, the Pro4000 will not be able to access files on drive A: The drive must be specified as part of the path command.*

To run ProShell, type "PS" at the DOS prompt and press <ENTER>.

▲ ProShell Main Screen

When you execute ProShell a screen similar to the following appears:



Title: The name and version of the program is displayed here. In this example, the name and version are ProShell v1.0.

Status Lines: The second and third lines of the display are the status lines. The first status line tells you the drive, the directory and subdirectory (if applicable), or which function is being performed (receive, transfer, make directory, etc.). On the above sample screen, the current drive is C:. The second status line displays information about the directory or file you have highlighted, or prompts you to enter information.

Drives: When selected, a list of available drives is shown.

Directories and Files: A list of directories and files within the current active directory are displayed on the left-hand side of the ProShell screen. Directories have square brackets around them. On the above sample screen, *Pro4000* and *Example* are directories, and *AUTOEXEC.BAT* and *CONFIG.SYS* are files stored on the C: drive.

Function Menu: The function key menu is outlined by a double lined window on the right-hand side of the screen.

Available Storage Space: Shows the number of bytes free on current drive.

▲ Selecting Directories or Files in ProShell

Press the keys described below to move the highlight bar to the drive, directory, or file on which you want to operate (to copy, view, edit, transfer, etc.).

Up or Down Arrow Keys

Use the arrows to move the highlight bar up or down by one position.

<PgUp> and <PgDn> Keys (Page Up or Page Down)

These keys are used to move the highlight bar up or down 12 positions at a time. If 12 files or directories do not exist on the drive, the highlight bar moves to the top or bottom of the file list respectively.

ENTER Key

The <ENTER> key is used to execute an implied command. The command that takes effect when <ENTER> is pressed depends on what file or drive is highlighted on the directory. There are three implied commands:

- 1) Change drives: To change drives, move the highlight bar to the word {Drives} and press <ENTER>. A list of available drives is shown. Highlight the drive you want to select and press <ENTER>. The letter of the current drive is displayed on the first status line.
- 2) Change directory: To change directories, highlight the desired directory name and press <ENTER>. The drive and directory (path) of the current directory are shown on the first status line.
- 3) Run a program or batch file: To run a program or batch file, highlight the desired filename and press <ENTER>. ProShell prompts you to enter any parameters that the program may need on the second status line. If the program does not require any parameters, press <ENTER> again. If you need to enter program parameters, type the parameters as you would at the DOS prompt then press <ENTER>. You can enter up to 10 parameters or a maximum of 80 characters. Press <ESC> if you want to abort the execution of the program or batch file.

▲ ProShell Functions

The DOS functions that ProShell offer are listed in the Function Menu. Select the directory or file and press the function key associated with the function you want to perform. These functions are described below:

<F1> Copy: This command copies a file or a group of files. To copy a file, highlight the file to copy and press <F1>. To copy a group of files, first mark each file with the <INS> key.

You are asked to enter the destination for the files to be copied on the second status line. You should enter the destination path (drive and directory) and filename. Press <ENTER> to execute the copy function. You do not need to type in a filename if you want to use the same filename as the highlighted file. If you type in a filename, note that wildcard characters (* and ?) are allowed as part of the destination or source filename. Press <ESC> to abort the Copy function.

❖ *Note: You cannot copy files to the ROM drive*

<F2> Edit: This function invokes ProEdit on your Pro4000. You use the Edit (<F2>) function to edit existing files only. Highlight the file you want to edit. (See *ProEdit Program* later in this Section for more details)

<F3> Move: This function is used to move files to other drives or directories, and to rename files. You can move one file or several files. If you want to move several files, first mark each file with the <INS> key.

To move a file, highlight the file and press <F3>. The program prompts you for the destination on the second status line. Enter the path of the location where the file is to be moved. You can specify a new name so that the file is renamed as it is moved to its new location by including the new filename within the destination path.

❖ *Note: You cannot move a file to the ROM drive*

To rename a file, highlight the desired file and press <F3>. The Pro4000 asks you to enter the destination path. At the prompt, enter the new filename and press <ENTER>. If you do not want a filename to have an extension, type the filename ending with a period. For example, "MYFILE ." would be listed in the directory without an extension.

At the prompt, you can cancel the rename function by pressing the <ESC> or <ENTER> key.

<F4> Mkdir: This command is used to create a new subdirectory in the current directory path. When <F4> is pressed, the program asks you to enter the name of the new subdirectory on the second status line. Enter the name and press <ENTER>. You can cancel the function by pressing <ESC> at the prompt. To remove a subdirectory, refer to the delete function (DEL).

<F5> Xfer: Use this function to send or receive files from another DOS computer using ProLink. (See *ProLink Programs* later in *Section 5* for details)

<INS> Mark: The insert key <INS> is used to mark and unmark files. To mark a file, move the highlight bar to the desired filename and press <INS>. A mark character (>) is placed to the left of the filename. To unmark a file, move the highlight bar to the desired marked file and press <INS>. The mark sign is removed from the left of the filename.

** Delete:** The delete key deletes (erases) a file, a group of files, or a subdirectory. To delete a file, highlight the file and press . To delete a group of files, first mark all the files to be removed and press . When the key is pressed, you are asked to confirm the deletion of these files. You must type in <Y> followed by <ENTER> if you want to proceed with the deletion. Any other keystroke aborts the file deletion.

❖ *Note: You cannot delete files from the ROM drive. If you try, it first appears as if the files were deleted, but after the next DOS operation the files will reappear in the directory.*

<ESC> Escape: The escape key <ESC> is used to abort functions if the program is at a prompt awaiting your input. Escape also exits the ProShell program. If you are exiting the program, you are asked to confirm that you want to exit. You must press <Y> at this prompt followed by <ENTER>.

<TAB> Utilities: The tab key <TAB> lets you access eight additional functions through a pop-up utility window. When <TAB> is pressed, the following functions are listed on the screen:

- | | |
|-------------|------------------|
| 1. Wildspec | 5. Unmark all |
| 2. Editor | 6. Sort by Ext. |
| 3. SetUp | 7. Display Delay |
| 4. Mark all | 8. Shell to DOS |

These utility functions are described below.

Utility Functions

- 1 Wildspec Lets you display all or a subset of files on the current directory. You can set a mask on the types of files you want to display. For example, if you only want to display files with the extension .DAI, you would use the Wildspec function to set the mask ".DAI ". The default setting for Wildspec is "*.*" which shows all files.

Scroll until "1. Wildspec" is highlighted and press <ENTER> or <1> to access the Wildspec function. The existing Wildspec setting will be displayed on the second status line. If you want to change this setting, press the <BS> (backspace) key to delete the existing setting and type in your Wildspec setting. Wildspec represents a file specification (1-8 character name). You can use the characters ? and * in the filename and an extension can be used to specify a group of files.
- 2 Editor Executes ProEdit. Use this function when you are creating a new text file (must be 64 K or less). After selecting this function, you must enter a name for the file to be edited on the second status line and then press <ENTER>. This function differs from the Edit <F2> function because <F2> requires an existing file to edit. (See *ProEdit Program* later in this section for details.)
- 3 SetUp Executes the *Pro4000 SetUp* program. (Refer to *Section 4, System SetUp Program* for details.)
- 4 Mark All Lets you mark all the files on the current directory at one time.
- 5 Unmark All Lets you unmark all the files on the current directory at one time.
- 6 Sort by Name/
Extension Lets you sort your files by name or by extension. You can toggle between the two options.
- 7 Display Delay Lets you set a display delay of 0 (default), 2, or 4 seconds, causing the display to pause after a program is executed before returning to the Shell program.
- 8 Shell to DOS Lets you temporarily access the DOS prompt without exiting from ProShell. To get back into ProShell program, type Exit and press <ENTER>.

File Transfer Programs

There are two file transfer programs, one that runs on the *Pro4000* called ProLink and one that runs on your computer called Lynx. These programs facilitate the transfer of files between the *Pro4000* and Windows-based computers.

To run Lynx, your computer must be running Windows 95 or higher and have at least one serial port.

▲ Setting Up Communication

Program Installation

ProLink is factory installed in the *Pro4000*'s ROM, drive A: When you are in ProShell, ProLink is automatically initiated. You do not need to do anything to start it.

Lynx must be installed on your PC. To install Lynx, insert the *Pro4000* Setup disk (utility disk #1) into the A: drive on your computer and run the Setup program from Windows. The Lynx icon will appear on your desktop when installation is complete.

Communication Cable

You need a null modem serial communication cable to connect the *Pro4000* to the desktop or laptop computer you want to transfer files to or from. If you plan to use a cable from another source besides Juniper Systems, check the wiring requirements found in *Section 2, Hardware Features, Communication Ports*.

Preparing the Pro4000 and the PC to Communicate

- 1) Connect one end of the serial communication cable to the serial port on the PC and the other end to either 9 pin serial communication port on the *Pro4000* (COM1 or COM2).
- 2) Turn on both the *Pro4000* and the PC.
- 3) Run ProShell on your *Pro4000* and Lynx on your PC.
- 4) Make sure the correct communication ports are selected on both computers and that the baud rates match.

Communication Ports

To set up the communication port on the PC, from Lynx select the "Transfer/Select COM Port" menu option. Select the port that the communication cable is connected to. (Details on how to use Lynx can be found later in this section)

To set up the communication port on the *Pro4000*, from the main ProShell screen press <F5> (Xfer). Press <F1> (COM) to toggle between COM1 and COM2 (the default port is COM1) Select the port that the communication cable is connected to on the *Pro4000*. The second status line of the ProShell display shows the selected port.

Baud Rates

We recommend that you leave the *Pro4000* in auto baud rate detection mode (the default setting) In this mode, the *Pro4000* tries to establish communication at 115K baud. If communication cannot be established at this rate, it automatically steps down to the next slower rate until communication is established.

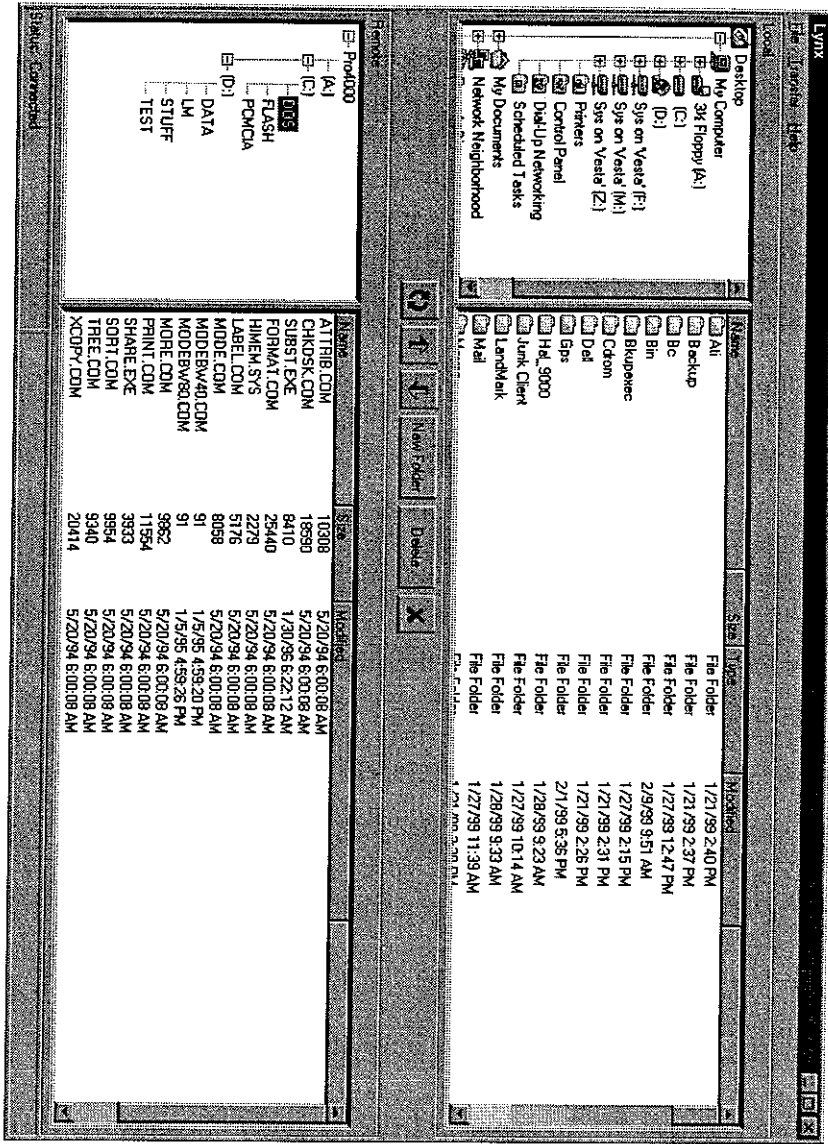
If you want to change the baud rate on the *Pro4000*, from the main ProShell screen press <F5> (Xfer) then <F2>. Use the up and down arrow keys to scroll up and down the baud rate list. When the desired baud rate is highlighted, press <ENTER>. Make sure that both the *Pro4000* and the PC are set to the same baud rate.

Making the Connection

Click the Connect button or select the "Transfer/Connect to Remote" menu option from Lynx. Once communication is established, you see the contents of your *Pro4000* FieldBook in the Lynx Remote view screen (see the sample screen on the following page).

▲ Overview of Lynx

When you start Lynx from your Windows Start Menu, two Windows Explorer-type screens are displayed. The top screen (Local) displays the contents of your PC. The bottom screen (Remote) displays the contents of the *Pro4000* once a connection has been made. Lynx allows you to manage files on your PC and the *Pro4000* using your PC. A sample Lynx screen is shown on the following page.



Sample Lynx Screen

File Management Features

You can perform many file management functions on your *Pro4000* FieldBook. The menu options are described below.

File Menu Options

- File/New Folder: Creates a new folder or sub-folder.
- File/Delete: Deletes a file or a folder
- File/Exit: Exits Lynx

Transfer Menu Options

- Transfer/Connect to Remote: Establishes a connection between the PC and the *Pro4000*
- Transfer/Send to Remote: Sends a file or folder from the PC (Local) to the *Pro4000* (Remote)
- Transfer/Receive from Remote: Sends a file or folder from the *Pro4000* (Remote) to the PC (Local)
- Transfer/Disconnect: Disconnects the communication link between the PC and *Pro4000*

Help Menu Options

- Help/Contents: A Table of Contents for Lynx Helps
- Help/Index: An index for Lynx Helps
- Help/Using Help: Describes how to use "Help"
- Help/About Lynx: Gives you information about the Lynx program
- Help/MS-DOS Help: Gives you information about the DOS utility programs

Shortcuts

In addition to using the pull-down menus, there are some buttons that provide shortcuts as described below.



The Connect button is used to establish a connection between the PC and the *Pro4000* (the same as the "Transfer/Connect to Remote" function)



The Up Arrow button is used to send a file or folder from the *Pro4000* (Remote) to the PC (Local) (the same as the "Transfer/Receive from Remote" function)



The down arrow button is used to send a file or folder from the PC to the *Pro4000* (the same as the "Transfer/Send to Remote" function)

New Folder

The New Folder button is used to create a new folder or sub-folder (the same as the "File/New File" function).

Delete

The Delete button is used to delete a file or folder (the same as the "File/Delete" function).



The Disconnect button is used to disconnect the communication link between the PC and *Pro4000* (the same as the "Transfer/Disconnect" function).

Managing Files With Lynx

You can perform many file management functions with Lynx. Some examples are given below.

Renaming a File

To rename a file, simply click on a selected filename in either the Local or Remote view screen and type a new filename into the edit box.

Creating a Sub-Folder

To create a new sub-folder, click on the appropriate parent folder and then click the New Folder button or select "File/New Folder" from the main menu.

Transferring Files to the Pro4000 from the PC

Transferring files between the *Pro4000* and the PC is also simple. To send files to the FieldBook from the PC:

- 1) Select the folder you want the files transferred to in the Remote view screen
- 2) Select the files you want to transfer to the FieldBook in the Local view screen using your mouse
- 3) Click the down arrow key (or select "Transfer /Send to Remote" from the main menu). You may be prompted for overwrite permission if the selected files already exist on the FieldBook. Otherwise the file transfer starts immediately.

Transferring Files to the PC from the Pro4000

You transfer files to the PC from the FieldBook in a similar manner:

- 1) Select the folder you want the files transferred to in the Local view screen
- 2) Select the files you want to transfer to the PC in the Remote view screen using your mouse
- 3) Click the up arrow key (or select "Transfer /Receive from Remote" from the main menu). You may be prompted for overwrite permission if the selected files already exist on the PC. Otherwise the file transfer starts immediately.

Disconnecting

When you are finished communicating with the FieldBook, click the Disconnect button or "File/Exit" from Lynx before disconnecting the serial cable. This action tells the FieldBook to stop waiting for additional commands from the PC. Otherwise you will have to press the ESC key on the FieldBook to return to normal function. Similarly, if you need to communicate with more than one FieldBook, you must click the Disconnect button before switching the serial cable to the next FieldBook.

Text Editor Program

There is a full screen text editor program that runs on the *Pro4000* called ProEdit. You can use this program to create and edit text files up to 64 K in size. For larger files, you will have to use another editor. This program can be accessed from ProShell (recommended) or directly from the DOS prompt.

▲ Starting a New Text File

Executing the Program From ProShell

To start a new text file, press the <TAB> key from the ProShell main menu to bring up the Utilities menu.

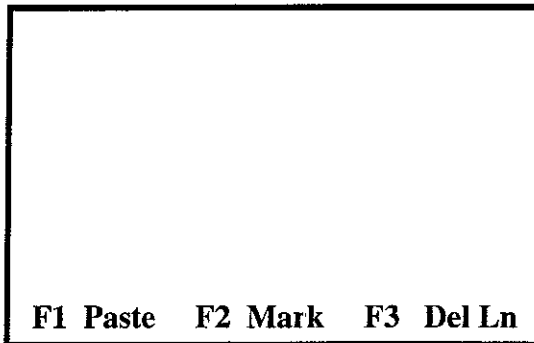
The screenshot shows the ProShell v1.0 main menu. At the top, it displays 'ProShell v1.0' and the current directory 'C:\Scale\DATA'. Below this, it shows file statistics: '7148' files, '03-10-99' date, and '11:06' time. A section titled '{Drives}' lists files with their extensions: 'Scale .EXE', 'Grade .TBL', 'Load .DFT', and 'QC .TBL'. To the right of this list is a utility menu with options: 'F1 Copy', 'F2 Edit', 'F3 Move', 'F4 MkDr', 'F5 Xfer', 'Ins Mrk', 'Del Del', 'Tab UtI', and '< Run'. Below the utility menu, the number '9328645' and 'ESC=Exit' are displayed. To the right of the utility menu, the text 'Press the TAB key' is written.

Select "2. Editor" from the Utilities menu to execute the ProEdit program. Enter a name for the new file on the second status line after the word File: and press <ENTER>.

Select
"2. Editor"

- Command
1. Wildspec
 2. Editor
 3. SetUp
 4. Mark all
 5. Unmark all
 6. Sort by Ext.

A blank page appears on the screen. You can now create a new file using the editing rules described later in this section.



Blank ProEdit Screen

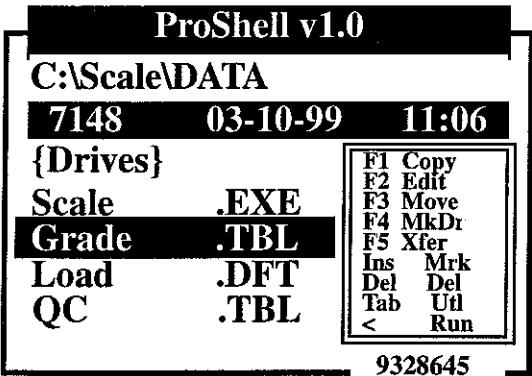
Executing the Program From DOS

At the DOS prompt, type "PE" for ProEdit and press <ENTER>. The program is executed and a blank page appears on the screen (see screen above). When you save the file, you will be asked to enter a filename.

▲ Accessing an Existing File

Accessing a File From ProShell

To access an existing file, select the desired file from the ProShell directory then press <F2>. This keystroke executes ProEdit and opens the file that is highlighted.



(1) Highlight the file you want to edit

(2) Press F2 to select edit

9328645
ESC=Exit

Accessing a File From DOS

At the DOS prompt, type "PE" for ProEdit followed by the name of the file to be edited and press <ENTER>. The program is executed and the file you selected is opened

▲ Editing a Document

Cursor Movement

To move the cursor one character at a time, the arrow keys are used:

To the right	Right Arrow
To the left	Left Arrow
Up one line	Up Arrow
Down one line	Down Arrow

To move the cursor to the start or end of a line:

To the beginning of a line	HOME
To the end of a line	END

To move the cursor one screen:

To previous screen	PgUp
To next screen	PgDn

To move the cursor to:

The beginning of the file	CTRL PgUp
The end of the file	CTRL PgDn

Function Keys

The function keys used for editing are paired as follows:



F6=cut
F1=paste



F7=Clear to
end of line
F2=mark



F8=delete line
F3=undelete line



F9=no function
F4=undelete
character



F10=external
display
F5=print
block

Inserting and Overwriting Text

You can enter text in insert mode or overwrite mode. Insert mode is the default. The word "Ins" is displayed at the bottom right corner of the display. (You have to pan over to see it.)

To insert text, position the cursor at the point where the new text is to start and begin typing. The existing text moves to the right as new text is inserted.

To switch to overwrite mode, press the <INS> key. The word "Ins" changes to "Ovr" on the display command bar, and the cursor changes to a block cursor. In overwrite mode, all the text to the right of the cursor is overwritten with new text.

To switch back to insert mode, press the <INS> key again.

Deleting Text

Text can be deleted one character at a time or one line at a time. To delete the character at the cursor, press the key. The character is removed from the screen, and the text from the right is shifted left one character. To delete to the left of the cursor, press the <BS> (backspace) key.

To delete a line, position the cursor anywhere on the line to be removed and press the <F8> key. The line is deleted and the lines below it move up. The line just deleted is placed in a buffer until another line is deleted and takes its place. The last line deleted can be pasted back into the document using the undelete line command, <F3>.

Undeleting Text

Text deleted with the or <BS> key can be restored at the cursor location *as long as the cursor has not moved to another line*. (Once the cursor is moved using the arrow keys the text is lost and cannot be recovered.) To undelete the removed text, press the <F4> key. Text removed using <F7> (clear to end of line) cannot be recovered.

Lines deleted using the <F8> key can be pasted back anywhere in the document by pressing the <F3> key.

Working With Blocks of Text

To mark a section of text as a block, press <F2>, the mark command, and use the arrow keys to block the text. Blocked text is displayed in reverse video.

Blocks of text can be cut (saved in a scratch buffer), pasted (copied from the scratch buffer to the current cursor location), or sent to a line printer.

To cut a block of text once it has been marked, press <F6>, the cut command key. The text is saved in a buffer and removed from the screen. The text to the right of the block is shifted to the left.

To paste a block of text from the scratch buffer, position the cursor where the text should be inserted and press <F1>, the paste key. To print a block of text press <F5>, the print key, while the block is marked. The marked text will be sent to the printer.

To copy a block of text, first mark it, then cut it, then paste it back in the original position. Now you can move the cursor to where you want the block copied and paste it again.

Exiting and Saving

To exit the editor, press <ESC>. The program asks you if the current text should be saved:

“Save Changes [Y/N]?”

At this point, if an <N> is pressed, the program exits without saving the text. If a <Y> is pressed, you are asked to enter a filename. If the file already has a name, the name is shown on the screen. You may use the backspace key to delete or modify the name. Pressing <ENTER> instructs the program to save the text in a file with the name specified and exit. The <ESC> key may be used at any time to abort the exit command.

Section 6

Operating System MS-DOS

-
- Operating System Overview
 - MS-DOS Commands
 - Batch Commands

Operating System Overview

The operating system of the *Pro4000* is MS-DOS 6.22. DOS provides the link between the *Pro4000* and your software and creates the environment in which you operate. Information on individual DOS commands follows later in this section.

You can operate your *Pro4000* by issuing standard DOS commands from the DOS prompt or through a program called ProShell (described in detail in *Section 5, Utility Programs*).

▲ Glossary of Terms

Following is a glossary of some basic terms relating to the operating system, memory, and data storage options. Some of these terms are described in greater detail in other sections of this manual.

AUTOEXEC.BAT File

An AUTOEXEC.BAT startup file contains default configuration information. There is an AUTOEXEC.BAT file on both the *Pro4000's* C: and A: drive. The *Pro4000* usually boots from the C: drive. Therefore, the AUTOEXEC.BAT on the C: drive is activated first. You can modify this file as needed for your application.

Byte

A byte can be thought of as the amount of space it takes to store one character.

CONFIG.SYS File

A CONFIG.SYS startup file contains default configuration information. There is a CONFIG.SYS file on both the *Pro4000's* C: and A: drive. Because the *Pro4000* boots from the C: drive on default, the commands in this CONFIG.SYS are activated. You cannot chain to other CONFIG.SYS files using MS-DOS. You can modify the CONFIG.SYS file on drive C: if required.

Disks and Disk Drives

Computer disks can be classified into two basic groups: Diskettes and hard drives (also called fixed drives). The *Pro4000* uses a solid state hard disk and PC card for program and data storage.

DOS

DOS is an acronym for Disk Operating System. Several brands of DOS have been created by various companies including PC-DOS, MS-DOS, and ROM-DOS. DOS consists of a set of commands or code which tells the computer how to process information. DOS runs programs, manages files, controls information processing, directs input and output, and performs many other related functions.

File

A file is a defined set of related information electronically stored on your *Pro4000* or PC. Examples: a letter, a database, or a program. Computer files are stored either in the computer's internal memory (RAM and ROM) or on storage media, typically disks (diskettes and hard drives).

Disk on Chip (Hard Disk)

The disk on chip is a solid state disk drive. It is the C: drive on the *Pro4000*. It can be read from and written to just like the hard drive on a PC.

Gigabyte

One gigabyte (GB) is thought of as one billion bytes (the actual figure is 1,073,741,824 bytes).

Kilobyte

One kilobyte (K or KB) is thought of as one thousand bytes (the actual figure is 1,024 bytes).

Megabyte

One megabyte (M or MB) is thought of as one million bytes (the actual figure is 1,048,576 bytes). The *Pro4000* comes with 2 M of RAM and 4 M or 12 M of disk storage.

PCMCIA Card (PC Card)

PCMCIA is an acronym for Personal Computer Memory Card Interface Association. When the proper software (device drivers) is installed on the *Pro4000*, an SRAM card or ATA FLASH card may be inserted in the slot provided. A PC card may also be a modem, RF transceiver, GPIB interface or several other possible devices. The *Pro4000* device drivers automatically detect these devices when they are installed in the PC card slot.

RAM (Random Access Memory)

RAM is often referred to as the computer's workspace. This is where programs are executed or run. RAM can be written to, read from, erased, etc. Its storage ability is temporary in nature, only holding information while the system has power.

ROM Disk (Read Only Memory)

ROM disks are different from RAM disks in that they are written to only once; upon original creation. Thereafter, they can only be read from much like a write-protected floppy disk. If you attempt to write to a ROM disk the *Pro4000* displays an error message. The ROM drive in the *Pro4000* is the A: drive.

MS-DOS

MS-DOS 6.22 is the operating system of the *Pro4000*. It is embedded in ROM (Read Only Memory) and can run entirely from within ROM.

▲ Startup Files

AUTOEXEC.BAT and CONFIG.SYS startup files containing default configuration information are stored in both the ROM and the C: drive. The startup files on the C: drive are used by the Pro4000 when it boots up. You can modify these files using a text editor. If the Pro4000 is booted from the A: drive the CONFIG.SYS and AUTOEXEC.BAT files on C: are not executed.

Each time you turn on the *Pro4000*, DOS searches for these files and carries out their commands.

The *Pro4000* startup files are configured at the factory as follows:

AUTOEXEC.BAT

```
path=a:\;c:\dos;c:\util;
prompt $p$g
loadhigh doskey
```

CONFIG.SYS

```
device=C:\DOS\HIMEM.SYS
device = C:\DOS\EMM386 EXE on x=a000-bfff x=e000-ffff
    noems ram=c000-dfff
dos=high,umb
devicehigh=c:\dos\power.exe
buffers=20
files=20
break=on
lastdrive=g
REM CardSoft(TM) 3.1 PCMCIA DRIVERS
devicehigh=C:\UTIL\CARDSOFT\SS365SL.EXE
devicehigh=C:\UTIL\CARDSOFT\CS.EXE
devicehigh=C:\UTIL\CARDSOFT\CSALLOC.EXE
devicehigh=C:\UTIL\CARDSOFT\ATADRV.EXE /S:1
devicehigh=C:\UTIL\CARDSOFT\MTSRAM.EXE
devicehigh=C:\UTIL\CARDSOFT\MTDDRIV.EXE
devicehigh=C:\UTIL\CARDSOFT\CARDID.EXE
REM End of card drivers
```

(Note: if you are going to load the operating system into High Memory, the first two lines shown above under CONFIG.SYS must be listed first. See *Section 3, Memory Configuration* for more details.)

Changing Startup Files

You may need (or want) to change the startup files. You can also add command lines to your AUTOEXEC.BAT file that tell the system to automatically load a specified program. Edit these files on the C: drive.

Bypassing Startup Files

If you have problems that you suspect are related to commands in your CONFIG.SYS or AUTOEXEC.BAT files, you can temporarily bypass both files or bypass individual commands within the files.

Bypassing All Commands

To bypass all the commands in both files, follow these steps:

1) Reboot the *Pro4000* by pressing the <ON/OFF> key for 8 to 10 seconds (just until the screen clears). After the system starts, DOS displays the following message:

Starting MS-DOS...

2) While this message is on your screen, quickly press and release the F5 key. DOS displays the following text:

MS-DOS is bypassing your CONFIG.SYS and
AUTOEXEC.BAT files.

The *Pro4000* will start with a basic configuration instead of your usual configuration. For example, device drivers for PC cards will not be loaded and environment variables will be set to their default values.

Bypassing Individual Commands

If you suspect your problems are related to a specific command, you can view each command individually and bypass only the command you think may be causing the problems. To review individual commands, follow these steps:

1) Reboot the *Pro4000* by pressing the <ON/OFF> key for 8 to 10 seconds (just until the screen clears). After the system starts, DOS displays the following message:

Starting MS-DOS ...

2) While the text is on your screen, quickly press and release the F8 key. One by one DOS displays each command in your CONFIG.SYS file followed by a prompt. To accept a command, press Y for yes. To bypass a command, press N for No.

3) When DOS finishes processing the CONFIG.SYS file, the following prompt appears:

Process AUTOEXEC.BAT [Y,N]?

If you also want to view the commands in your AUTOEXEC.BAT file, press Y for yes.

MS-DOS Commands

Pro4000 Command Subset

A subset of the most commonly-used MS-DOS commands is stored on the C: drive of the *Pro4000*. To view the available commands, select the "DOS" directory from the ProShell main menu. To view the DOS Help, highlight "DOSHELP" and press <F2> (Edit). The commands are listed alphabetically. Use the arrow keys to move to the command you want to read about. A description of each command is shown along with the required syntax and some examples. Use the panning keys to view this information as needed.

Full Command Set

The full MS-DOS command set is included on the *Pro4000* Utility Software disks, numbers 2 and 3. To view a list of the MS-DOS commands included on the disks, start Lynx on your PC. Select "Help/DOS Help" from the menu. As described above, the commands are listed alphabetically. To view a command, highlight it and press <Enter>. A complete description of each function is shown along with the required syntax and some examples.

Any MS-DOS commands may be transferred to the C: drive on the *Pro4000* using Lynx (refer to *Section 5, Utility Programs* for details)

Batch Commands

A batch file or batch program is an unformatted text file that contains one or more MS-DOS commands and is assigned a .BAT extension. When you type the name of the batch program at the command prompt, the commands are carried out as a group.

Any MS-DOS command you use at the command prompt can also be put in a batch program. In addition, the following MS-DOS commands are specially designed for batch programs:

<Call>	<If>
<Choice>	<Pause>
<Echo>	<Rem>
<For>	<Shift>
<Goto>	

You can use the COMMAND /Y command to step through a batch program line by line, and can selectively bypass or carry out individual commands. This is useful for tracking down problems in batch files. For more information, see COMMAND in from the "DOS Help" file.

Section 7

Technical Reference

-
- Specifications
 - ASCII Character Sets
 - BIOS Messages

Specifications

PROCESSOR

- 486 AMD processor, AMD SC 400

OPERATING SYSTEM

- MS-DOS 6.22

CLOCK SPEED

- 33/66 MHz 16 bit AT bus

SOFTWARE INCLUDED

- ProShell DOS Shell Program, ProEdit Communication Program, and ProEdit Text Editor pre-installed in ROM on the *Pro4000*
- Lynx File Management Utility
- DataPlus for DOS Application Generation Software (*Pro4000 Plus Package*)

SIZE

- 10.75 x 4.30 x 1.9 inches; 87.8 cubic inches

WEIGHT

- 2.34 lbs with standard battery pack (1.06 Kg)

TEMPERATURE RANGE

- Operating (with heater): -22 to +130°F (-30 to +54°C)
- Storage: -22 to +140°F (-30 to +60°C)

CASE DESIGN

- Waterproof: submersible in water at 1 foot depth for 1 minute
- Shockproof: can withstand a 4 foot drop onto concrete

SERIAL PORTS

- Two 9 pin RS-232C ports; 50 to 115.2 Kbaud transfer rate (programmable); standard 16550 UART; ± 12 V signal levels

DISPLAY

- High-contrast LCD with backlight
- 16 lines x 24 characters (text mode)
- CGA graphics; 192 x 128 pixels
- Virtual window full screen panning, 25 lines x 80 characters
- LCD heater

KEYBOARD

- Option 1: sealed elastomeric keypad with 59 alphanumeric keys color coded to function, separate numeric keypad, 12 function keys, and special DOS control keys.
- Option 2: rugged membrane keypad with 39 keys

DISK STORAGE

- 4 M or 12 M solid state disk for internal program and data storage (fully read/writeable)
- User-accessible PC card slot accepts standard PC 2.0 Type I or Type II memory cards and Type II input/output cards (fax/modem, GPS,

INTERNAL MEMORY

- 2 M low power RAM for program execution

PCMCIA CARD SLOT

- Accepts standard PCMCIA 2.0 Type I or Type II memory cards and Type II input/output cards

POWER

- Rechargeable NiCad pack; removable/field replaceable
 - Standard pack: Lasts 12 to 18 hours, typical use (1700 mAh)
 - Heavy-duty pack: Lasts 24 to 36 hours, typical use (3400 mAh)
- Features battery voltage indicator and warnings
- Super capacitor protects RAM while battery pack is being changed
- Real time clock is powered by a lithium battery that last about 5 years

CLOCK

- Internal battery backed clock/calendar

CERTIFICATIONS

- FCC Class B, CE Mark approved
- The Pro4000 is Year 2000 compliant

All specifications are subject to change without notice

ASCII Character Sets

Any character code from the IBM standard (0-127) or extended (128-255) character set may be entered by pressing and holding the <ALT> key while keying in the character code on the number keys. The ALT-nnn function can be enabled (default) or disabled through the extended BIOS function 2E11h (refer to the *Programming Guide*).

▲ Standard ASCII Character Set

Dec	Hex	Sym.	Dec	Hex	Sym.	Dec	Hex	Sym.	Dec	Hex	Sym.
0	00		32	20		64	40	@	96	60	ˆ
1	01	^A	33	21	!	65	41	A	97	61	a
2	02	^B	34	22	"	66	42	B	98	62	b
3	03	^C	35	23	#	67	43	C	99	63	c
4	04	^D	36	24	\$	68	44	D	100	64	d
5	05	^E	37	25	%	69	45	E	101	65	e
6	06	^F	38	26	&	70	46	F	102	66	f
7	07	^G	39	27	'	71	47	G	103	67	g
8	08	^H	40	28	(	72	48	H	104	68	h
9	09	^I	41	29	)	73	49	I	105	69	i
10	0A	^J	42	2A	*	74	4A	J	106	6A	j
11	0B	^K	43	2B	+	75	4B	K	107	6B	k
12	0C	^L	44	2C	,	76	4C	L	108	6C	l
13	0D	^M	45	2D	-	77	4D	M	109	6D	m
14	0E	^N	46	2E	.	78	4E	N	110	6E	n
15	0F	^O	47	2F	/	79	4F	O	111	6F	o
16	10	^P	48	30	0	80	50	P	112	70	p
17	11	^Q	49	31	1	81	51	Q	113	71	q
18	12	^R	50	32	2	82	52	R	114	72	r
19	13	^S	51	33	3	83	53	S	115	73	s
20	14	^T	52	34	4	84	54	T	116	74	t
21	15	^U	53	35	5	85	55	U	117	75	u
22	16	^V	54	36	6	86	56	V	118	76	v
23	17	^W	55	37	7	87	57	W	119	77	w
24	18	^X	56	38	8	88	58	X	120	78	x
25	19	^Y	57	39	9	89	59	Y	121	79	y
26	1A	^Z	58	3A	:	90	5A	Z	122	7A	z
27	1B	^_	59	3B	;	91	5B	[	123	7B	{
28	1C	^`	60	3C	<	92	5C	\	124	7C	|
29	1D	^]	61	3D	=	93	5D	]	125	7D	}
30	1E	^^	62	3E	>	94	5E	^	126	7E	~
31	1F	^_	63	3F	?	95	5F	_	127	7F	←

▲ Extended ASCII Character Set

Dec	Hex	Sym.	Dec	Hex	Sym.	Dec	Hex	Sym.	Dec	Hex	Sym.
128	80	Ç	160	A0	á	192	C0	Ł	224	E0	α
129	81	à	161	A1	â	193	C1	ł	225	E1	β
130	82	á	162	A2	ó	194	C2	Ť	226	E2	Γ
131	83	â	163	A3	ô	195	C3	Ŧ	227	E3	π
132	84	ã	164	A4	ñ	196	C4	—	228	E4	Σ
133	85	ä	165	A5	Ñ	197	C5	•	229	E5	σ
134	86	å	166	A6	•	198	C6	†	230	E6	μ
135	87	ç	167	A7	•	199	C7	‡	231	E7	τ
136	88	è	168	A8	¿	200	C8	‡	232	E8	φ
137	89	é	169	A9	ƒ	201	C9	ƒ	233	E9	θ
138	8A	ê	170	AA	ƒ	202	CA	ƒ	234	EA	Ω
139	8B	í	171	AB	½	203	CB	ƒ	235	EB	δ
140	8C	î	172	AC	¼	204	CC	ƒ	236	EC	∞
141	8D	ï	173	AD	¡	205	CD	=	237	ED	∞
142	8E	ÿ	174	AE	«	206	CE	±	238	EE	ε
143	8F	ÿ	175	AF	»	207	CF	±	239	EF	∩
144	90	ÿ	176	B0	■	208	D0	±	240	F0	≡
145	91	æ	177	B1	■	209	D1	ƒ	241	F1	±
146	92	Æ	178	B2	■	210	D2	ƒ	242	F2	≥
147	93	ó	179	B3	—	211	D3	ƒ	243	F3	≤
148	94	ø	180	B4	—	212	D4	ƒ	244	F4	∫
149	95	ø	181	B5	—	213	D5	ƒ	245	F5	∫
150	96	ù	182	B6	—	214	D6	ƒ	246	F6	∫
151	97	ù	183	B7	—	215	D7	ƒ	247	F7	∫
152	98	ÿ	184	B8	—	216	D8	ƒ	248	F8	∫
153	99	ÿ	185	B9	—	217	D9	ƒ	249	F9	∫
154	9A	ÿ	186	BA	—	218	DA	ƒ	250	FA	∫
155	9B	ƒ	187	BB	—	219	DB	■	251	FB	√
156	9C	£	188	BC	—	220	DC	■	252	FC	η
157	9D	ƒ	189	BD	—	221	DD	■	253	FD	∫
158	9E	£	190	BE	—	222	DE	■	254	FE	∫
159	9F	ƒ	191	BF	—	223	DF	■	255	FF	∫

BIOS Messages

▲ Troubleshooting

When the *Pro4000* powers up, it goes through a series of internal tests and diagnostics. This is called the Power On Self Test (POST). During these tests, messages are displayed on the screen or a series of beeps are heard. If you see an error message during this process, try resetting the *Pro4000* by holding the <ON/OFF> key down for 8 to 10 seconds. If the error persists, contact our Customer Service Department.

Section 8

Programming Guide

-
- Introduction
 - Power Management
 - Keyboard and Video
 - Extended BIOS Functions
 - Hardware Interrupt Listing
 - I/O Port Mapping
 - AI Keyboard Scan Codes
 - Keyboard Key-Code Tables

Introduction

The Programming Guide includes technical information for programmers. This information enables the programmer to run the *Pro4000* FieldBook as efficiently as possible in terms of speed and current consumption. Watch our web site for more programming tips in the future.

Power Management

The *Pro4000* has several power management functions integrated with the BIOS. Applications may use these functions to greatly enhance performance and battery life. There is an internal automatic Power Manager, which may be set off or on, and five levels of processor speed, from 0 (miser) to 4 (hyper).

There is a trade-off between battery life and speed. As the speed is increased it uses more power and thus batteries drain quicker. For optimal power management the processor runs fast only when it needs to, and is slowed or stopped during idle periods, such as when it is doing nothing while waiting for a keystroke or other input. In general, the power levels will be set by the user in the System Setup program (refer to *Section 4, System Setup Program, Power Management Screen* for more details).

Better power management can be achieved when an application is written to take control of the Power Manager. The most effective way to implement power management in an application is to control the processor when an application is idly waiting for keyboard input. The processor can be put into a low power sleep mode while waiting for the keystroke, and resume normal processing when the key is pressed. Another common case is when the application intermittently needs to perform some bulk processing of data. In this case the processor is put into high speed mode only while the processing is taking place, and restored to the user setting once processing is completed. This practice allows the user to set to a low power mode and yet not have to wait while bulk processing is taking place.

The Power Manager tries to speed up and slow down the CPU in this way, but it can only guess the needs of the system based on activity it can monitor. This type of power management is not nearly as effective as handling it at the application level through programming practices.

On the following pages, three sample functions are written in C and assembly language to take advantage of power management features on the *Pro4000*. Refer to the Extended BIOS Function section for more information.

Pro4000 Get Keystroke Function (Pro4000_Getch())

The following function can be used to put the *Pro4000* to sleep while waiting for a keystroke

```
char Pro4000_Getch(void)
{
    while(!kbhit())    // do sleep function until key is pressed
    {
        _asm
        {
            push    ax
            push    bx
            mov     ax, 2F19h
            mov     bl, 10000000b    //load regs for sleep call
            int    10h            //call sleep function
            pop     bx
            pop     ax
        }
    }
    return(getch());    /right
}
```

Pro4000 CPU Busy Function (Pro4000_CpuBusy)

This function overrides the Power Manager and causes the CPU to enter a high power state. It remains in this state until the *Pro4000_CpuDone* function is called. It is used to temporarily speed up the CPU when data needs to be processed rapidly.

```
void Pro4000_CpuBusy (void)
{
    _asm
    {
        push    ax
        push    bx
        mov     ax, 2E0Bh
        mov     bl, 0            // setup regs for function call
        int    10h            // call cpu busy function
        pop     bx
        pop     ax
    }
}
```

Pro4000 CPU Done Function (Pro4000_CpuDone)

This function is called to restore the Power Manager to the normal state after a CPU busy call.

```
void Pro4000_CpuDone(void)
{
    _asm
    {
        push    ax
        push    bx
        mov     ax, 2E0Bh
        mov     bl, 1           // setup regs for function call
        int    10h           // call cpu done function
        pop     bx
        pop     ax
    }
}
```

Keyboard and Video

A programmer can use the keyboard and video interrupt functions to control the keyboard and video screens. These functions are described below.

Keyboard Intercept Functions

BIOS interrupt 15h function 4Fh may be hooked to intercept raw (not yet translated) scan codes from the keyboard. The scan codes at this level are unique to the *Pro4000*. Refer to the system scan codes in the Scan Code Tables found at the end of this section.

BIOS interrupt 15h function 4Eh may be hooked to intercept translated scan codes from the keyboard. The scan codes at this level are standard 2 byte scan/ASCII character codes. The keys on the keyboard may be remapped to output alternate characters through this interrupt.

Video

The *Pro4000* display is a CGA-compatible 192x128 pixel monochrome LCD. It displays 24 column x 16 line text (video mode 3) with a virtual 80 column x 25 line page. It does not support multiple 80x25 virtual pages. Text attributes can be set to black/white, where CGA colors are mapped to either full on or full off, and gray shades, where CGA colors map to various shades of gray. This setting can be changed either in user System Setup program or through BIOS int 10h function 2F23h.

Graphics modes supported are CGA mode 4 (320x200 pixel) with 4 shades of gray, and CGA mode 6 (640x200 pixel) where pixels are either on or off. In either case, the upper left 192x128 pixels are displayed on the LCD. Standard BIOS interrupt 10h functions are used to set the video mode. Only modes 3, 4, and 6 are supported.

An auto-pan function may be enabled or disabled to cause the 24x16 display to pan with the cursor around the 80x25 virtual window. Extended BIOS functions may also be used to locate the display anywhere on the virtual window. In this way multiple 24x16 "pages" can be set up on the single 80x25 window.

Extended BIOS Functions

Following is a summary of the extended BIOS services that are available through the use of an extended interrupt function BIOS call. The functions are placed in register AH. The subfunctions are placed in register AL. You then invoke INT 10h. When the subfunction requires data input (for example, to set the contrast), the data byte or word is generally passed in register BL or BX. The output byte is returned in register AL. An unsuccessful operation will exit the function with the carry bit set.

<u>Function</u>	<u>Sub-Function</u>	<u>Meaning</u>
AH = 2Eh	AL = 00h	Pan Left 40%
	AL = 01h	Pan Right 40%
	AL = 02h	Pan Up
	AL = 03h	Pan Down
	AL = 04h	Pan XY
	AL = 06h	PC Card Power while in Suspend
	AL = 07h	Suspend System
	AL = 0Ah	Get Pro4000 Status Byte
	AL = 0Bh	CPU Busy/Done
	AL = 0Ch	Disable BIOS Power Manager
	AL = 0Dh	Enable BIOS Power Manager
	AL = 0Eh	DTR Control for COM 1
	AL = 0Fh	Get CPU version
	AL = 10h	Get Keypad Shift Flag Settings
	AL = 11h	Set Keypad Shift Flag Settings
AH = 2Fh	AL = 00h	Read status byte
	AL = 01h	Read video contrast
	AL = 06h	Read the thermistor
	AL = 07h	Read the A/D reference
	AL = 08h	Read the main battery voltage
	AL = 0Ch	Set backlight off
	AL = 0Dh	Set backlight on
	AL = 0Eh	Set heater off
	AL = 0Fh	Set heater on
	AL = 10h	Set key beep off
	AL = 11h	Set key beep on
	AL = 12h	Power down system
	AL = 13h	Put system in reboot mode
	AL = 14h	Put system in resume mode
	AL = 15h	Set auto sleep duration
	AL = 16h	Set video contrast
	AL = 18h	Get Performance Level
	AL = 19h	Set Performance Level
	AL = 1Ah	Set auto-panning off
	AL = 1Bh	Set auto-panning on
AL = 1Eh	Read miscellaneous BIOS setup bytes	
AL = 23h	Video Attributes	

▲ Function AH=2Eh

Subfunction: AL = 00h (pan left 40%)

Pans screen left 40%. If screen is at leftmost limit, no action is taken. Returns nothing.

Subfunction: AL = 01h (pan right 40%)

Pans screen right 40%. If screen is at rightmost limit, no action is taken. Returns nothing.

Subfunction: AL = 02h (pan up)

Pans screen to top 16 rows of 25 row virtual display. Returns nothing.

Subfunction: AL = 03h (pan down)

Pans screen to bottom 16 rows of 25 row virtual display. Returns nothing.

Subfunction: AL = 04h (pan xy)

Locates the upper left corner of 24x16 display window to row/column specified on the virtual 80x25 display. Call with BH=row (values are 0-8), BL=column (values are 0-55). Returns nothing.

Subfunction: AL = 06h (pc card power while in suspend)

Determines whether to leave PC Card powered when the system is suspended or to turn power off. Some cards may draw substantial current even when suspended and may need to be powered down during suspend so the *Pro4000's* batteries are not drained.

Call with:

BL=00h	return current setting in AL
BL=01h	power off during suspend
BL=02h	power on during suspend (default)

Subfunction: AL = 07h (suspend Pro4000)

Suspends the *Pro4000* to low power suspend state and remains there until a valid wakeup event occurs. Calling this function is identical to pressing the on/off key when the system is in suspend/resume mode. Returns nothing.

Subfunction: AL = 0Ah (get Pro4000 status byte)

Returns status byte in AL where:

b7-b1	=	reserved
b0	=	power manager setting 1=on, 0=off

Subfunction: AL = 0Bh (set cpu busy/done)

Applications should set CPU busy when a block of processing needs to be performed. CPU busy overrides power manager and keeps the CPU running fast for as long as it is set. CPU done should be called after CPU busy to tell the CPU that processing is complete and the *Pro4000* can return to a lower power state. WARNING: CPU busy will drain the batteries rapidly and should only be enabled when needed. Returns nothing.

Call with: BL=00h CPU busy
 BL=01h CPU done

Subfunction: AL = 0Ch (disable BIOS power manager)

Disables automatic power management functions in the BIOS. The *Pro4000* generally uses less power with power manager enabled. Returns nothing.

Subfunction: AL = 0Dh (enable BIOS power manager)

Enables automatic power management functions in the BIOS. The system generally uses less power with power manager enabled. Returns nothing.

Subfunction: AL = 0Eh (get/set dtr line on com 1)

Controls behavior of the COM 1 DTR line as follows:

BL=00h	RS-232 signal (default)
BL=01h	+5 Volt DTR signal
BL=02h	+5 Volt On
BL=03h	+5 Volt Off
BL=04h	+5 Volt Auto
BL=05h	return current setting in AL

Subfunction: AL = 0Fh (get CPU version)

Returns CPU version as follows: AL=version major (b7-b4)+version minor (b3-b0).

Subfunction: AL = 10h (get keypad shift flag settings)

Returns current shift flag settings in AL. See Subfunction AL=11h.

Subfunction: AL = 11h (set keypad shift flag settings)

The keyboard shift flags (<ctrl>, <alt>, <shift>) can be individually controlled such that when the key is pressed it will register as either left, right, or both scan codes. The <alt>-nnn function can be enabled/disabled with this function.

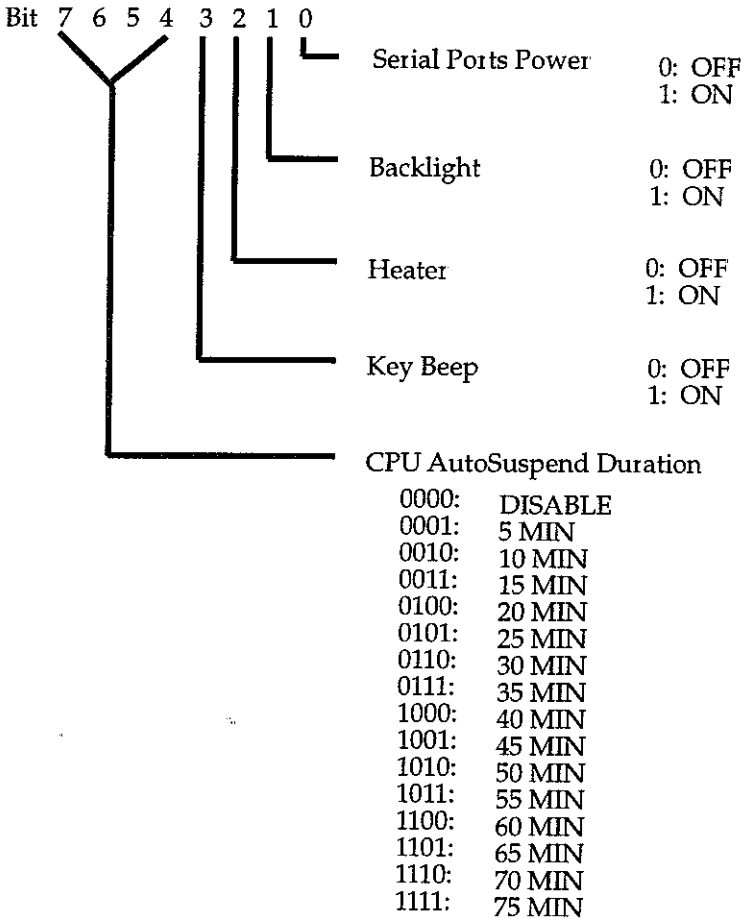
Call with: BL=b7-b0 where:

b1,b0	=	01	R <shift> only
		10	L <shift> only
		11	Both (default)
b3,b2	=	01	R <alt> only
		10	L <alt> only
		11	Both (default)
b5,b4	=	01	R <ctrl> only
		10	L <ctrl> only
		11	Both (default)
b6	=	0	Disable <alt>-nnn
		1	Enable <alt>-nnn (default)
b7	=		Reserved

▲ Function AH=2Fh

Subfunction: AL = 00h (read status byte)

Output: AL = Status Byte, where:



Subfunction: AL = 01h (read video contrast)

Output: AL = Video Contrast

The range of video contrast is from 0 to 63.

Subfunction: AL = 06h (read the internal thermistor)

Output: AL = Temperature Reading ($T(C) = [(50 \div 37) * AL] - 277$)

The value returned in the AL register is the temperature in degrees C.

Subfunction: AL = 07h (read analog to digital reference)

Output: AL = A/D Reference Voltage

This should always read FFh. It gives an indication of the correct operation of the A/D.

Subfunction: AL = 08h (read main battery voltage)

Output: AL = Main Battery Voltage Level

The value returned in the AL register is the voltage reading of the main battery. The range of this reading is from 0 to 10V (0=0V, FFh=10V).

Subfunction: AL = 0Ch/AL = 0Dh (turn backlight off/on)

AL = 0Ch turns the display backlight off. AL = 0Dh turns the display backlight on. Returns nothing.

Subfunction: AL = 0Eh/AL = 0Fh (set heater off/on)

AL = 0Eh turns the display heater off. AL = 0Fh turns the display heater on. Returns nothing.

❖ *Note: When the temperature of the Pro4000 rises above 0° C, the display heater is turned off. The temperature is checked every five minutes. You may turn the heater on again, but in five minutes, when the temperature is checked, it will be turned off (if the temperature is still above 0° C). The display does not require the heater when the temperature of the Pro4000 is above 0° C.*

Subfunction: AL = 10h/AL = 11h (set key beep off/on)

AL = 10h turns the key beep off. AL = 11h turns the key beep on. Returns nothing.

Subfunction: AL = 12h (power down system)

When the subfunction is executed, the Pro4000 turns off. It is also capable of shutting down the Pro4000 in resume mode. Returns nothing.

Subfunction: AL = 13h (put system in reboot mode)

When it is executed, the Pro4000 is set to reboot mode. In this mode the on/off key will cause power to be turned off. Returns nothing.

Subfunction: AL = 14h (put system in resume mode)

When it is executed, the *Pro4000* is set to resume mode. In this mode, the power is not completely shut off. The *Pro4000* is still running but at very low power, so it appears to be off. When the key is pressed the *Pro4000* will resume where it left off.

Subfunction: AL = 15h (set auto suspend duration)

This subfunction requires an input value to set the auto suspend duration. The input value is passed in the BL register. There is no output.

If BL = 00h	auto suspend is disabled	08h	duration = 40 min
01h	duration = 5 min	09h	duration = 45 min
02h	duration = 10 min	0Ah	duration = 50 min
03h	duration = 15 min	0Bh	duration = 55 min
04h	duration = 20 min	0Ch	duration = 60 min
05h	duration = 25 min	0Dh	duration = 65 min
06h	duration = 30 min	0Eh	duration = 70 min
07h	duration = 35 min	0Fh	duration = 75 min

Subfunction: AL = 16h (set video contrast)

This subfunction requires an input value to set the video contrast ratio. The input value is passed in the BL register and has a range of 00h to 63h. There is no output to the AL register.

Subfunction: AL = 18h (get Performance Level)

The purpose of this function is to read the current Performance Level.

Output: AL = 00h	Miser
01h	Low
02h	Medium
03h	High
04h	Hyper

Subfunction: AL = 19h (set Performance Level)

This subfunction requires an input value to set the Performance Level. The input value is passed in the BL register. Valid register values are shown below.

BL = 00h	Miser
01h	Low
02h	Medium
03h	High
04h	Hyper

No value is returned to the AL register.

❖ *Note: If the seventh bit is set (e.g., 1XXXXXX, X = 0 or 1), the system is put into a low power mode (i.e., "sleep" where processor is turned off) until the next system function is invoked. The speed is not changed when the system is put to "sleep".*

Subfunction: AL = 1Ah/AL = 1Bh (set auto panning off/on)

There is no output for these subfunctions. AL = 1Ah turns auto-panning off. AL = 1Bh turns auto-panning on.

Subfunction: AL = 1Eh (read miscellaneous BIOS setup bytes)

Input: None

Output: AL = Miscellaneous System Setup Flags

Miscellaneous System Setup Flags Bit information:

- bit 0 0 = Reboot Mode, 1 = Resume Mode
- bit 1 Reserved
- bit 2 Reserved
- bit 3 Reserved
- bit 4 Reserved
- bit 5 0 = Auto-panning Active,
1 = Auto-panning Inactive
- bit 6 Reserved
- bit 7 0 = Black and White, 1 = Gray Scale (video)

Subfunction: AL = 23h (video)

This routine sets the display to black and white or to 64 gray shades.

- BL = 00h B/W 1
- 01h Gray Scale (16 shades)
- 02h B/W 2
- 03h Return current setting in AL

This function controls how the BIOS maps CGA colors to LCD gray scale. B/W 1 and B/W 2 map all colors to either black on white or white on black to increase viewability for some programs. B/W 1 is faster than B/W 2 but will only work on programs which go through the BIOS for video text output. B/W 2 should work on all programs but is less efficient than B/W 1.

❖ *Note: This function is applicable only to text mode*

Hardware Interrupt Listing

The following chart shows the interrupt-level assignments in decreasing priority.

Level	Function
Microprocessor NMI Interrupt Controllers CTRL 1 CTRL 2	Parity or I/O Channel Check
IRQ 0	Timer Output 0
IRQ 1	Keyboard (Output Buffer Full)
IRQ 2	Interrupt from CTRL 2
IRQ 8	Real Time Clock Interrupt
IRQ 9	Not Used*
IRQ 10	Not Used*
IRQ 11	Not Used*
IRQ 12	Not Used*
IRQ 13	Not Used
IRQ 14	Not Used*
IRQ 15	Not Used*
IRQ 3	Serial Port 2
IRQ 4	Serial Port 1
IRQ 5	Not Used*
IRQ 6	Not Used
IRQ 7	Not Used*

*PC Card IRQ assigned by Card and Socket Services.

I/O Port Mapping

Address	Function
080	Diagnostics Port
2F0 - 2F3	System Control Registers
2F8 - 2FF	COM2:
3D0 - 3DF	CGA Display
3E0 - 3E7	PC Card Controller
3F8 - 3FF	COM1:

AT Keyboard Scan Codes

The scan codes on the *Pro4000* keyboard have been configured as shown in the following chart:

Shft, Ctrl, Alt	Can be configured to use scan codes for either right, left, or both sides (default) of AI keyboard (see extended BIOS function 2E11h)
Home, PgUp PgDn, End, Ins, Del	Uses scan codes from dedicated (gray) keys
Arrow Keys	Uses scan codes from dedicated (gray) keys
Number Keys	Uses scan codes from top row keys of keyboard (not the 10-key keypad)

Keyboard Key-Code Tables

Keyboard Legend		System Scan Codes (hex)	Character Codes				AH/AL (hex)
Normal	Blue		Normal	Shift	Ctrl	Alt	
F1		3B	3B/00	54/00	5E/00	68/00	
	F6	40	40/00	59/00	63/00	6D/00	
F2		3C	3C/00	55/00	5F/00	69/00	
	F7	41	41/00	5A/00	64/00	6E/00	
F3		3D	3D/00	56/00	60/00	6A/00	
	F8	42	42/00	5B/00	65/00	6F/00	
F4		3E	3E/00	57/00	61/00	6B/00	
	F9	43	43/00	5C/00	66/00	70/00	
F5		3F	3F/00	58/00	62/00	6C/00	
	F10	44	44/00	5D/00	67/00	71/00	
Tab		0F	0F/09	0F/00	94/00	A5/00	
	Back Tab	5B		0F/00			
Ctrl		1D					
	Pr-Scr	70			72/00		
Alt		38					
	Scr-Lk	46					

Keyboard Legend		System Scan Codes (hex)	Character Codes				AH/AL (hex)
Normal	Blue		Normal	Shift	Ctrl	Alt	
Esc		01	01/1B	01/1B	01/1B	01/00	
	F11	57	85/00	87/00	89/00	8B/00	
BS		0E	0E/08	0E/08	0E/7F	0E/00	
	F12	58	86/00	88/00	8A/00	8C/00	
7		08	08/37	08/26		7E/00	
	7	08	08/37			7E/00	
8		09	09/38	09/2A		7F/00	
	8	09	09/38			7F/00	
9		0A	0A/39	0A/28		80/00	
	9	0A	0A/39			80/00	
Ins		52	52/E0	52/E0	92/E0	A2/00	
	Ins	52	52/00				
▲		48	48/E0	48/E0	8D/E0	98/00	
	PgUp	49	49/E0	49/E0	84/E0	99/00	
RED + ▲		72					
4		05	05/34	05/24		7B/00	
	4	05	05/34			7B/00	
5		06	06/35	06/25		7C/00	
	5	06	06/35			7C/00	

Keyboard Legend		System Scan Codes (hex)	Character Codes				AH/AL (hex)
Normal	Blue		Normal	Shift	Ctrl	Alt	
6		07	07/36	07/5E	07/1E	7D/00	
	6	07	07/36		07/1E	7D/00	
◀		4B	4B/E0	4B/E0	73/E0	9B/00	
	Home	47	47/E0	47/E0	77/E0	97/00	
RED + ◀		71					
▶		4D	4D/E0	4D/E0	74/E0	9D/00	
	End	4F	4F/E0	4F/E0	75/E0	9F/00	
RED + ▶		73					
1		02	02/31	02/21		78/00	
	1	02	02/31			78/00	
2		03	03/32	03/40	03/00	79/00	
	2	03	03/32		03/00	79/00	
3		04	04/33	04/23		7A/00	
	3	04	04/33			7A/00	
Del		53	53/E0	53/E0	93/E0	A3/00	
	Del	53	53/E0				
▼		50	50/E0	50/E0	91/E0	A0/00	
	PgDn	51	51/E0	51/E0	76/E0	A1/00	
RED + ▼		74					

Keyboard Legend		System Scan Codes (hex)	Character Codes			AH/AL (hex)	
Normal	Blue		Normal	Shift	Ctrl	Alt	
Blue		7E					
Ø		ØB	ØB/3Ø	ØB/29		81/ØØ	
	Ø	ØB	ØB/3Ø	ØB/29		81/ØØ	
		34	34/2E	34/3E		34/ØØ	
	-	ØC	ØC/2D	ØC/5F	ØC/1F	82/ØØ	
Enter		1C	1C/ØD	1C/ØD	1C/ØA	1C/ØØ	
	Enter	1C	1C/ØD	1C/ØD	1C/ØA	1C/ØØ	
A		1E	1E/61	1E/41	1E/Ø1	1E/ØØ	
	|	2B	2B/5C	2B/7C	2B/1C	2B/ØØ	
B		3Ø	3Ø/62	3Ø/42	3Ø/Ø2	3Ø/ØØ	
	/	35	35/2F	35/3F		35/3F	
C		2E	2E/63	2E/43	2E/Ø3	2E/ØØ	
		6B		27/3A		27/ØØ	
D		2Ø	2Ø/64	2Ø/44	2Ø/Ø4	2Ø/ØØ	
	+	65	ØD/2B	ØD/2B			
E		12	12/65	12/45	12/Ø5	12/ØØ	
	*	5D	Ø9/2A	Ø9/2A		7F/ØØ	
F		21	21/66	21/46	21/Ø6	21/ØØ	
	=	ØD	ØD/3D	ØD/2B		83/ØØ	

Keyboard Legend		System Scan Codes (hex)	Character Codes				AH/AL (hex)
Normal	Blue		Normal	Shift	Ctrl	Alt	
G		22	22/67	22/47	22/07	22/00	
	^	66	07/5E	07/5E		7D/00	
H		23	23/68	23/48	23/08	23/00	
	\$	67	05/24	05/24	05/34	7B/00	
I		17	17/69	17/49	17/09	17/00	
	%	62	06/25	06/25			
J		24	24/6A	24/4A	24/0A	24/00	
	#	68	04/23	04/23		7A/00	
K		25	25/6B	25/4B	25/0B	25/00	
	<	69	33/3C	33/3C		33/00	
L		26	26/6C	26/4C	26/0C	26/00	
	>	6A	34/3E	34/3E		34/00	
M		32	32/6D	32/4D	32/0D	32/00	
	&	6D	08/26	08/26		7E/00	
N		31	31/6E	31/4E	31/0E	31/00	
	@	6C	03/40	03/40	03/00	79/00	
O		18	18/6F	18/4F	18/0F	18/00	
	_	63	0c/5F	0c/5F	0c/1F	82/00	

Keyboard Legend		System Scan Codes (hex)	Character Codes				AH/AL (hex)
Normal	Blue		Normal	Shift	Ctrl	Alt	
P		19	19/70	19/50	19/10	19/00	
	|	64	2B/7C	2B/7C	2B/1C	2B/00	
Q		10	10/71	10/51	10/11	10/00	
	(	5C	0A/28	0A/28		80/00
R		13	13/72	13/52	13/12	13/00	
	)	5E	0B/29	0B/29		81/00
S		1F	1F/73	1F/53	1F/13	1F/00	
	,	33	33/2C	33/2C		33/00	
T		14	14/74	14/54	14/14	14/00	
	!	5F	02/21	02/21		78/00	
U		16	16/75	16/55	16/15	16/00	
	?	61	35/3F	35/3F		35/00	
V		2F	2F/76	2F/56	2F/16	2F/00	
	;	27	27/3B	27/3B		27/00	
W		11	11/77	11/57	11/17	11/00	
	[	1A	1A/5B	1A/5B	1A/1B	1A/00
X		2D	2D/78	2D/58	2D/18	2D/00	
	]	1B	1B/5D	1B/5D	1B/1D	1B/00

Keyboard Legend		System Scan Codes (hex)	Character Codes			AH/AL (hex)
Normal	Blue		Normal	Shift	Ctrl	
Y		15	15/79	15/59	15/19	15/00
	"	60	28/22	28/22		28/00
Z		2C	2C/7A	2C/5A	2C/1A	2C/00
	'	28	28/27	28/27		28/00
Space		39	39/20	39/20	39/20	39/20
Shift		2A				
	CapsLk	3A				
Red		7F				

Appendix

Operating Instructions for Charging Accessories

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- SafeCharger Battery Pack Charger
 - SmartCharger Battery Pack Charger

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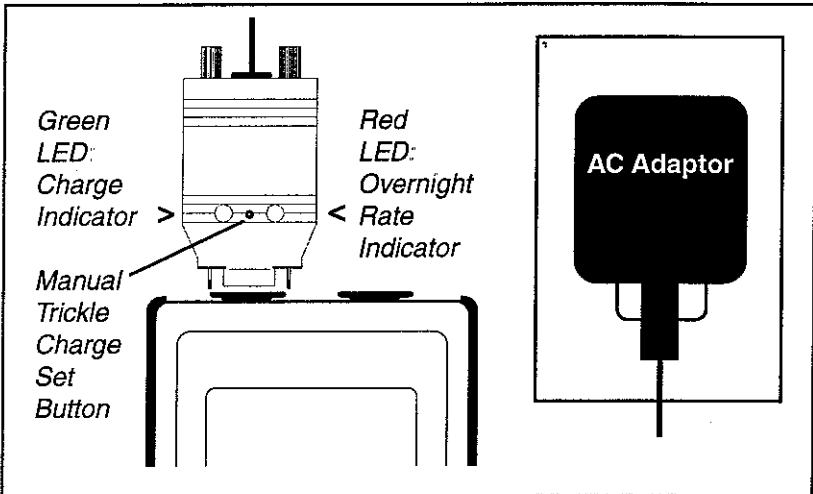
SafeCharger Battery Pack Charger

The SafeCharger is a timed charger with two functions:

- ❑ Recharging the *Pro4000* battery pack over a 12 hour period (overnight charge rate).
- ❑ Maintaining the charge of the battery pack and backup battery during periods of disuse (trickle charge mode).

▲ How to Use the SafeCharger

- 1) Leave the battery pack attached to the *Pro4000*.
- 2) Plug the AC charging adaptor into a 110V (or 220V) AC outlet
- 3) Insert the charger's connector into the 9 pin connector (COM1) on the *Pro4000* and tighten the thumbscrews.



Green and Red LEDs

There is a red and a green LED (light emitting diode) on the face of the connector. When you plug the power adaptor into the wall socket and attach the SafeCharger to COM1 on the *Pro4000*, both LEDs turn on.

Green LED

The green LED is the charge indicator. When it is on, everything is connected correctly and the *Pro4000* is being charged. If the green LED does not come on, it is not charging. Make sure the battery is installed, the charger is connected to COM1, and the AC outlet you plugged the power adaptor into is energized.

Red LED

The red LED is the overnight rate indicator. When it is on, the charger is in the overnight charge rate. The *Pro4000* is given a full charge over 12 hours. The charger then automatically switches to trickle charge mode and the red LED turns off. You can leave the *Pro4000* in trickle charge mode continuously without damaging the batteries, allowing you to keep it charged over the weekend and during inactive periods.

Manually Switching to Trickle Charge Mode

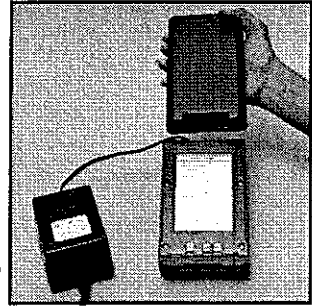
You can manually switch the SafeCharger to trickle charge mode by gently inserting a pointed object into the trickle charge set button found between the LEDs. The green LED stays on and the red LED turns off, indicating that the charger is in trickle charge mode.

❖ *Note: If there is a power failure which lasts for more than a few seconds, the SafeCharger will switch back to overnight charge mode for 12 hours then return to trickle charge mode.*

SmartCharger Battery Pack Charger

The SmartCharger fast-charges *Pro4000* battery packs. It also provides a deep discharge cycle for long-term battery maintenance.

The SmartCharger charges a fully discharged battery pack in about 2 hours. It takes approximately 8 hours to discharge a fully charged pack and about 3 hours for a pack that is 50% charged.



▲ SmartCharger Features

- Fast Charge Capabilities
- Selectable Discharge Option
- LED Status Indicators
- 110 Volt and 220 Volt Power Supply Options

▲ Components

A SmartCharger includes the following components:

- 1) Model PW-SC SmartCharger
- 2) Power Supply Adaptor: you should have one of the following:
 - PW-WB110 110 Volt Power Supply Adaptor
 - PW-WB220 220 Volt Power Supply Adaptor
 - PW-CIG-SC Cigarette Lighter Adaptor

Note: The SmartCharger will work with all of the power supply options listed above without any internal adjustments.

- 3) User's Manual

▲ Toggle Switch and LEDs

Located on the front panel of the SmartCharger are 3 red LEDs (light emitting diodes) and a toggle switch. The SmartCharger label gives you a basic explanation of the LED and switch features.

Refer to the chart below for more details.

LED/Switch	Status	Meaning
Power LED	On	Power applied.
	Off	No power applied
	Flashing Rapidly	SmartCharger failed during self test and may need to be repaired. Contact our customer service department.
	One Flash	ERROR. The pack is not taking a charge. The battery cells may be shorted.
	Two Flashes	ERROR. The pack voltage was too low after the charge cycle was complete. The battery cells are probably shorted.
	Three Flashes	ERROR. The terminal charge voltage is too high. This usually means that the battery has a high internal resistance, a signal that the battery's useful life is about over.
Four Flashes	ERROR. The SmartCharger is unable to discharge the battery pack and may need to be repaired. Contact our customer service department.	
Charge LED	On	Fast-charge cycle underway.
	Off	Fast-charge finished; trickle charge underway; or, no battery pack attached.
	Flashing	ERROR. SmartCharger is out of allowable operating temperature range (+50° to 104° F, +10° to 40° C). It will resume charging the pack once the temperature is within the allowable range (after a 15 minute delay).
Discharge LED	On	Discharge cycle underway.
	Off	Discharge finished or not enabled.
	Flashing	ERROR. SmartCharger is out of allowable operating temperature range (+50° to 104° F, +10° to 40° C). It will resume discharging the pack once the temperature is within the allowable range (after a 15 minute delay).
Discharge Switch		<p>To begin discharge cycle: press switch to the right during fast charge cycle.</p> <p>To cancel discharge cycle: press switch to the right during discharge cycle.</p>

▲ Installation

Plug the power supply adaptor into a power outlet (110 VAC for the PW-WB110, 220 VAC for the PW-WB220). Plug the connector from the power supply adaptor into the connector located in the back of the SmartCharger. When power is applied, the Power LED turns on after a few seconds and remains on as long as there is power. (If the power LED flashes, refer to the chart on the previous page for an explanation) The SmartCharger is now ready to charge a Pro4000 battery pack.

❖ *Important Note: Make sure the SmartCharger is plugged in before a battery pack is inserted. Do not operate the SmartCharger in extreme hot or cold conditions. Typical room temperature is ideal (+50° to 104° F, +10° to 40° C). Both the SmartCharger and the battery pack need to be within this temperature range, or damage to the battery pack could occur.*

▲ Normal Charge Cycle

The SmartCharger automatically runs a normal charge cycle without discharging the battery. The time required for a normal charge depends on how deeply the battery pack was discharged prior to being placed on the SmartCharger. For a fully discharged pack (standard or heavy-duty), a charge cycle takes approximately 2 hours.

To start the normal charge cycle, simply slide the battery pack onto the SmartCharger. After a few seconds, the Charge LED comes on. When the Charge LED goes off, the pack is charged and ready to use. (If the charge LED is flashing, refer to the chart on page 4.)

After the pack is fully charged, the SmartCharger goes into a trickle charge mode, maintaining the fully charged state of the pack until it is removed and preventing the batteries from over-charging.

▲ Discharge Cycle

You should periodically deep discharge battery packs before charging them. It takes approximately 8 hours to discharge a fully charged pack and about 3 hours for a pack that is 50% charged. To start the discharge cycle, follow these steps:

- 1) Insert the pack and wait for the Charge LED to come on.
- 2) Press the Discharge On/Off switch to the right until the Discharge LED comes on. Release the switch. If you change your mind about running the discharge cycle, press the switch to the right

again until the Discharge LED goes off and the Charge LED comes on. Note: If the pack is already discharged, toggling the switch will not cause the Discharge LED to come on. This protects the pack from over-discharging.

3) The SmartCharger senses when the pack is discharged and begins the charge cycle automatically. The Discharge LED goes off and the Charge LED comes on.

We recommended that the discharge cycle only be used periodically. Deep discharging the battery pack each time the pack is charged reduces the life (number of charge/discharge cycles) of the pack. If the packs are charged each day and only slightly discharged to about the same level, then you should deep discharge the packs about once every 1 to 2 months.

Battery Discharge Characteristics

NiCad batteries have extremely stable voltage characteristics during discharge, and the voltage drop occurs suddenly at the end of discharge. The standard end voltage (discharged battery) adapted for NiCad batteries is 1.0 volts per cell. *Pro4000* battery packs have 5 cells in a series so that when the voltage level reaches 5.0 volts, the batteries are completely discharged in terms of their effective use. During the discharge cycle, the SmartCharger discharges the batteries down to approximately 5.0 volts.

For more details on the *Pro4000* battery pack and backup batteries, refer to *Section 2, Hardware Features, Batteries*

▲ An Important Note About Power Interruptions

The SmartCharger must be reset if a battery is installed and power is interrupted. Instructions on how to reset the SmartCharger are given below:

- 1) If the SmartCharger is plugged in, unplug it as soon as possible after the power is interrupted.
- 2) Remove the battery pack from the SmartCharger.
- 3) Plug the SmartCharger in.
- 4) Re-install the battery pack onto the SmartCharger.
- 5) If the pack was being discharged, start the discharge cycle again.

If the SmartCharger is not reset after a power interruption, the following problems can occur:

- When power is restored to the SmartCharger before it is reset, the SmartCharger cannot switch to trickle charge mode when the battery is fully charged. The SmartCharger stays in the high charge rate, causing it to over-charge the battery. If the charged battery is left on the SmartCharger, the battery gets very hot and can be damaged.
- When power is not restored and the pack remains on the charger, the SmartCharger discharges the battery pack.

▲ Troubleshooting Guide

- 1) The Power LED does not come on immediately when I plug in the SmartCharger.

This is normal. It takes the SmartCharger several seconds to initialize

- 2) The Power LED never comes on

Make sure the power adaptor is plugged in properly. If that is not the problem, the fuse may be blown in the power adaptor. Call our customer service department for repair information.

- 3) The LEDs are flashing.

Flashing LEDs indicate error conditions. Refer to the chart earlier in this section for an explanation.

- 4) The SmartCharger Power and Charge LEDs come on when a pack is inserted, even when the unit is not plugged in

The SmartCharger is drawing power from the battery pack and discharging it. If you want to charge or discharge the pack, remove it, plug the SmartCharger in, then re-insert the pack. If you don't want to charge or discharge the pack, remove it from the SmartCharger

- 5) It is not taking very long to charge a pack

The pack is already charged

▲ Specifications

AC Requirements:

120 VAC @ 60Hz; 220 VAC @ 50 Hz

DC Requirements:

Charging: 1.5A @ 13.5 volts

Trickle Charge: 0.1A @ 13.5 volts

Charging Temperature Range:

+50° to 104° F (+10° to 40° C)

Discharge Time:

Approximately 8 hours for a fully charged pack.

Charge Time:

Approximately 2 hours for fully discharged pack.

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